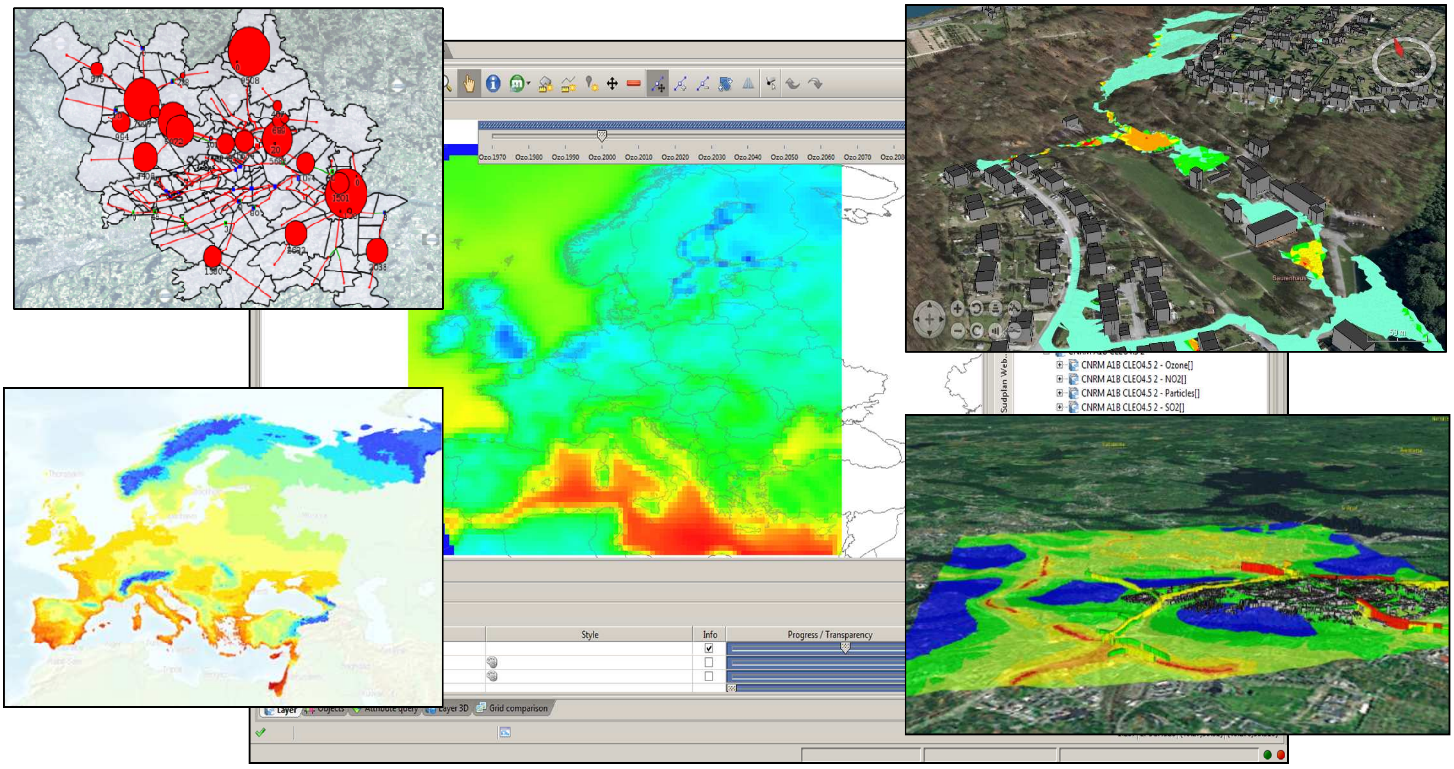
SUDPLAN



PROJECT FINAL REPORT

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4.1 Final publishable summary report

4.1.1 Management summary

The SUDPLAN project has developed a software tool to be used by urban planners assessing the environmental impacts of stormwater flooding, hydrological conditions and air quality in the urban environment, under present and future conditions taking into account climate change scenarios. The primary target users for SUDPLAN products are scientific users and city planners as well as environmental service providers.

The SUDPLAN tool is an Environmental Decision Support System (EDSS) with two principle software components, the ***Scenario Management System (SMS)*** and the ***Common Services (CS)***. The graphical user interface of the SUDPLAN tool is found as part of the SMS. The environmental information and downscaling[1] models available in CS are operated through the SMS.

The SMS is built up by three distinct building blocks: the SMS Framework, Model as a Service Integration and Advanced Visualisation. The SMS can be seen as a generic integration platform that is able to facilitate climate change induced urban development planning in any city in Europe. It contains a large variety tools to visualise time series and spatial data, including advanced 3D/4D presentations.

CS facilitate the access and visualisation of climate, hydrological and air quality information on the Pan-European scale. The basic information are the regionally downscaled climate scenarios forced by different global climate model outputs on the borders outside Europe. The Pan-European information allows further urban downscaling of intense rainfall, hydrological conditions and air quality. The input required for the three types of downscaling are high resolution time series of precipitation, daily time series of river discharge and gridded city emissions, respectively.

SUDPLAN provides the means to downscale rainfall, hydrological and air quality data for a specific city, taking climate change into consideration. With end-user's local model integrated in the SMS, the output from CS can be seamlessly used as input for local model simulations. Moreover, the integration, visualisation and information management of local planning scenarios are supported. Through this SUDPLAN integrates the effects of climate change into urban planning processes on all levels from the Master Plan to the individual permit.

Four pilots have represented the end-user community during the project. The ***Wuppertal pilot*** has applied the SUDPLAN tool to find cost-effective measures to mitigate the risk of flooding during heavy rainfall. Measures are evaluated by manipulating the high-resolution digital elevation model (DEM) data and then test the effects of the measures through simulations with local models GeoCPM[2] and DYNA[3]. Typical storm events can historically be taken from measurements while future information is obtained from CS climate scenario output. The ***Linz pilot*** has a similar SMS

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[1] The downscaling concept is central in SUDPLAN and is used for the modeling performed to obtain environmental information, based on climate model scenarios, on a spatial and temporal scale useful for urban and regional planning. See also *Urban downscaling* in Section 6. Glossary.

[2] GeoPCM is a software component for the simulation of hydrodynamic surface run-off (manufacturer: tandler.com GmbH / Pecher AG)

[3] DYNA is a software component for hydrodynamic analysis of sewage systems (manufacturer: tandler.com GmbH / Pecher AG)

integration of a local hydrodynamic model SWMM 5[4], here used to minimize and control the discharge of polluted waste water at combined sewer overflows (CSOs) into receiving waters. The key performance indicator for this type of spill from combined sewer systems is CSO efficiency, for which there is a proposed guideline in Austria. The SUDPLAN tool allows to use local models to simulate CSO efficiency either on the basis of historical rainfall time series data or using precipitation time series from CS downscaling under future conditions with a changed climate.

The ***Stockholm and Czech pilots*** have both used the SUDPLAN tool to assess future air quality in the Stockholm-Uppsala and Prague regions, respectively. The projections of urban air pollution levels up to the year 2030 show a minor effect of climate change, in comparison with the impact that expected changes in European and local emissions of particles and pollutants will have. The CS air quality downscaling has also been used by the two pilots to compare and assess the consequences of larger traffic, industrial and residential planning scenarios, existing as possible or already initiated projects in Stockholm and Prague.

The hydrological application has been tested and validated for Swedish catchment areas through collaboration between the SUDPLAN team and the Swedish Water Authority.

At project end a total of 57 persons, of them 33 external to the project, have validated and given feedback on the SUDPLAN tool. Nearly all answers where very positive about the results, the available user interface, the models and the available data. Most persons also stated that the information provided by SUDPLAN was either new, of better quality or more useful as information available before. Although there were comments and recommendations how to improve the tool and make it more easy to use, the overall conclusion is that the final results generated by this single tool were found unique and of interest for most types of urban planners.

The scientific progress has been reported in a large number of conferences world-wide, including two dissemination events organized by the project team. Peer-reviewed scientific publications include contributions to one scientific book on extreme rainfall, 3 open access publications in scientific journals and 24 peer-reviewed conference papers. The progress and achievements of the SUDPLAN project have been documented in detail in 78 deliverables. Most of this large dissemination material is publically available on the SUDPLAN website:

http://www.sudplan.eu/

The SUDPLAN consortium has signed business/exploitation agreements to assure that the present pilot cities have operational access to SUDPLAN services and to allow the design, setup and operation of new commercial SUDPLAN services for other cities in Europe and world-wide.

[4] SWMM (Storm Water Management Model) is a hydrodynamic rainfall-runoff simulation model made available by US-EPA as open source.

4.1.2 Project facts

4.1.2.1 Background

The SUDPLAN project responded to the ICT-2009.6.4 call for environmental services and climate change and specifically to the target a) formulated as:

a) ICT for a better adaptation to climate change

Easy-to-use, web-based systems for better preparedness, decision support and mitigation of climate change impact on population, utilities and infrastructures. Special emphasis is on scenario-based prediction, damage assessment, planning and training, 3D/4D modelling, simulation and visualisation, as well as sensor networks. Integrated solutions shall be validated in the urban context including for natural disasters, taking full advantage of recent advances in miniaturisation of sensors, wireless communications and increased computation power and data storage capacity.

The SUDPLAN project has been running three years from 1st January 2010 to 31st December 2012 with participation of nine partners from Sweden, Germany, Austria and the Czech Republic:

- Swedish Meteorological and Hydrological Institute – SMHI (co-ordination, Sweden)
- Austrian Institute of Technology GmbH – AIT (Austria)
- cismet GmbH (Germany)
- Czech Environmental Information Agency – CENIA (Czech Republic)
- Apertum IT AB (Sweden)
- German Research Centre for Artificial Intelligence – DFKI (Germany)
- Stockholm-Uppsala Air Quality Management Association – SULVF (Sweden)
- City of Wuppertal (Germany)
- Graz University of Technology – TUG (Austria)

The partners are grouped in three categories: Environmental (SMHI, TUG), information technology (cismet, AIT, Apertum, DFKI) and end-users (CENIA, SULVF, City of Wuppertal).

4.1.2.2 Objectives and general approach

The SUDPLAN project was developed to fulfil five major objectives:

A. To design and implement a scenario management, execution, visualisation, documentation and training environment for scientific users and city managers

B. By applying the system, to improve information and service quality in the area of risks for flooding, heavy rainfalls and severe air pollution episodes, affecting urban infrastructure and population and under the influence of a changed climate.

C. To design and implement services to quantify, report and visualise the future risks for flooding, extreme rain intensities and high air pollution events over urban areas (the so-called Common Services), usable throughout Europe, which contribute to standardisation at pan-European level.

D. To achieve the above objectives in such a way, that the SUDPLAN services can easily collaborate with existing, established infrastructures, and that the SUDPLAN services achieve a maximum of flexibility and adaptability to national or regional differences, and to do so in an efficient way.

E. To validate (implement and evaluate) the innovative approach in four different diverse pilot applications (the City of Stockholm pilot in Sweden, the City of Wuppertal pilot in Germany, the City of Linz pilot in Austria and the Czech Prague regional pilot), to ensure that the approach is generic, easy to use for service providers and end-users and is easily transferable to other sites.

In very summarized and simple terms, the project task has been to develop **a software tool to be used by urban planners assessing the environmental impacts of stormwater flooding, hydrological conditions and air quality in the urban environment, under present and future conditions taking into account climate change scenarios**.

Considering the use of software tool in the urban planning process, SUDPLAN's approach is to provide two key elements of climate change aware urban planning:

1. Downscaled climate change projections of environmental variables based on an ensemble of climate scenarios, and
2. functionalities necessary to consider and evaluate the effect of Climate Change in local planning processes including climate data integration support facilities, model control, and scenario management as well as advanced visualization capabilities.

SUDPLAN provides the means to downscale rainfall, hydrological and air quality data, taking climate change into consideration. These data can be used as input for local models. Moreover, the integration, visualisation and information management of local planning scenarios are supported. The main objective is to provide the means to integrate the effects of climate change into urban planning processes on all levels from the Master Plan to the individual permit.

To obtain urban scale climate change data in SUDPLAN, the end-user provides local data to improve the downscaling of environmental information reflecting a future climate change (Figure 1). This approach makes it possible to deliver projections in the right scale for the local planning process.

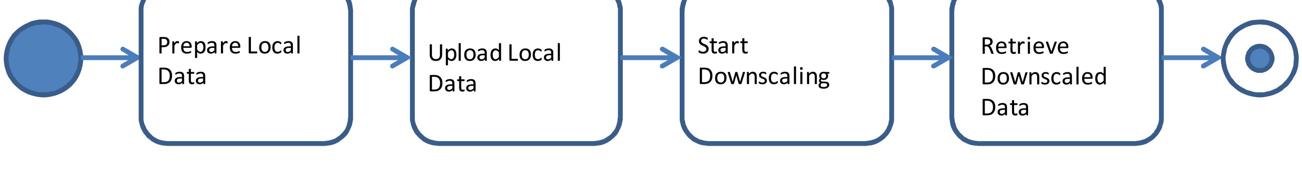

Figure 1: Retrieve downscaled information of climate change effects on the urban environment

The downscaled data (including future) can be used just like the regular local data (only historical). For example, local models can be fed with downscaled data (Fig. 2). This infuses the effect of climate change into the local model. Planners can use their conventional local models to produce local model experiments (local scenarios) where climate change is considered.

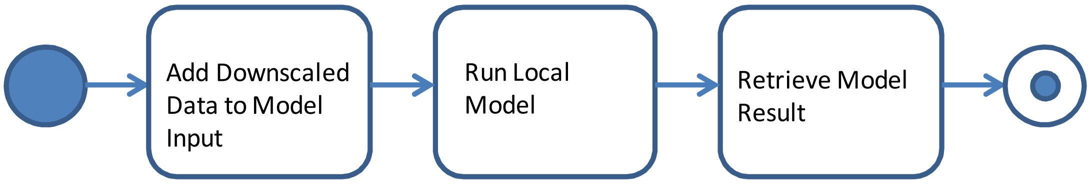

Figure 2: Use Downscaled Data to Run Local Model Scenario

Downscaled data based on different climate scenarios can be used as input to local planning scenarios to illustrate the uncertainty of the climate change effect. Intervals of possible climate change effects can be identified and thus sound adaptation strategies can be considered in the plan.

The applicability of this approach to a large variety of purposes is supported by the use of prominent open standard service interfaces. The transfer of time series or gridded data is through OGC Sensor Observation Services (SOS) and the model execution takes place through the OGC Sensor Planning Services (SPS). The use of these two standard interfaces also allows external users to access Climate Change information in a well-defined manner and to incorporate Climate Change data into an individual application.

4.1.2.3 Targeted end-users

Users from the regional and urban scale have had a key role in the project, ensuring that the final product(s) meet their needs and expectations. By involving planners and decision makers in the urban context, environmental experts and system developers at the same time a wide range of requirements could be collected, addressing very different aspects of a powerful scenario management environment.

The primary target users for SUDPLAN products are scientific users and city planners as well as environmental service providers. While scientific users may be able to use such services directly (for instance by using a combination of tools, or by programming scientific analysis software themselves), many city planners in administration either lack the computer skills and/or the resources to such independent development. Even for scientific users, who are capable of handling a multitude of software tools, it is not desirable that they waste precious time on overcoming the barriers between different tools. Thus the SUDPLAN tool saves time and effort for the scientific group of users and it allows city planners to include all relevant information, including future climate scenarios, in their assessments of urban planning scenarios.

4.1.2.4 Project organization

The project has been executed in nine work packages:

WP1: Co-ordination and management (Lars Gidhagen, SMHI, lars.gidhagen@smhi.se)

WP2: Product Concept and Validation (Peter Kutschera, AIT)

WP3: Scenario Management System (Sascha Schlobinski, cismet)

WP4: Common Services (Jonas Olsson, SMHI)

WP5: Stockholm Pilot (Christer Johansson, SULVF)

WP6: Wuppertal Pilot (Stefan Sander, City of Wuppertal)

WP7: Linz Pilot (Günter Gruber, TUG)

WP8: Czech regional pilot (Jan Mertl, CENIA)

WP9: Dissemination and Exploitation (Eleonor Marmefelt / Stefan Andersson, SMHI)

4.1.2.5 Project website

The SUDPLAN website is available at http://www.sudplan.eu/

4.1.3 SUDPLAN results

4.1.3.1 Overview SUDPLAN system and services

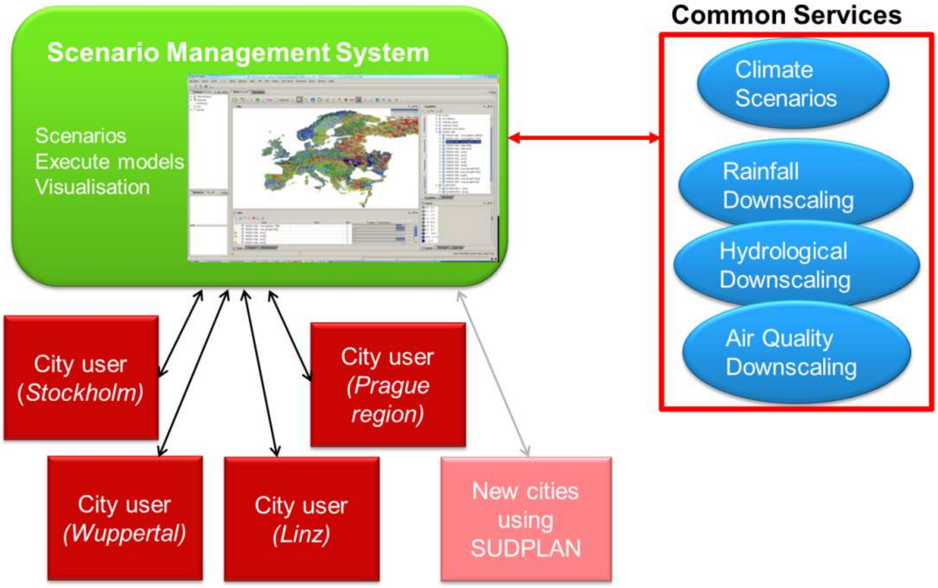

Figure 3: Overview of SUDPLAN main components

The SMS and the CS access to Pan-European information can be used to downscale rainfall, hydrological conditions and air quality in whatever European city. This way of working with Common Services models and output directly contributing to urban assessments is demonstrated by the Stockholm and Czech pilots.

With local models also integrated into the SMS GUI, the assessments can go down in scale and allow the assessment of small-scale structures as e.g. of drainage and/or sewer systems or the design of residential areas and individual roads. The integration of local models into the SMS GUI is easy and is demonstrated by the Wuppertal and Linz pilots.

4.1.3.2 Common Services

Common Services facilitate the access and visualisation of climate, hydrological and air quality information on the Pan-European scale. The basic information is the regionally downscaled climate scenarios forced by different global climate model outputs on the borders outside of Europe. The climate scenarios used during the project come from 5 different global climate model (GCM) results representing 4 different GCMs and 2 different greenhouse gas emission scenarios, see Table 1. The downscaling over Europe has been performed with SMHI RCA3 regional climate model outputting a spatial resolution of 50x50 km^2. All scenarios span 1960 to 2100 and include 10-year averages, annual averages, monthly and daily averages of temperature and precipitation. The four used for rainfall downscaling do also have 30-min precipitation data.

Table 1: Climate scenarios available during the project for visualisation of temperature and precipitation (all 5) and those available as input to further downscaling. AQ emissions only relevant for air quality applications.

Scenario (GCM)	AQ emissions	Rainfall	Hydrology	Air Quality
ECHAM5_A1B	RCP4.5	X	X	X
ECHAM5_A2		X		
HADCM3_A1B	RCP4.5	X	X	X
CCSM3_A1B		X		
CNRM-CM3_A1B	RCP4.5			X

Table 2: Hydrological output for spatial visualisation and time series export on the Pan-European scale

Raw model output (daily/monthly/annual/10-year)	
Mean Q	River discharge
Mean specific runoff	Local runoff
Mean relative soil moisture	The soil moisture deficit in the root zone (in mm), in relation to the field capacity
Groundwater	Relative groundwater level
DBS[5]-corrected temperature	Temperature after preparation for hydrological simulation by DBS scaling
DBS-corrected precipitation	Precipitation after preparation for hydrological simulation by DBS scaling
Statistical output (only available as 30-year mean)	
Cout_highflow-T10	The discharge magnitude that on average occurs once every 10 years.
Cout_highflow-T50	The discharge magnitude that on average occurs once every 50 years.
Mean High Flow (MHQ)	The mean annual high water discharge in a river/stream.
Mean Low Flow (MLQ)	The mean annual low water discharge in a river/stream
Hydrological drought, number of days	The number of days (per year) with hydrological drought. This is defined as the number of days when the flow is higher than the 10th percentile of the flow in the reference period.
Hydrological drought, intensity	The intensity of hydrological drought, i.e. how much below a threshold value for the reference period the flow is for the dry days.
Agricultural drought, number of days	The number of days with agricultural drought. Similar to the hydrological drought, but based on days over the 90th percentile of the relative soil moisture compared to the reference period.
Agricultural drought, intensity	The intensity of agricultural drought, i.e. how much above a threshold value for the reference period the relative soil moisture is for the dry days.

While gridded temperature and precipitation are visualised for all scenarios, for the hydrological scenarios there is also a list of variables for each catchment areas of the >35 000 sub-basins building up Europe, see Table 2.

[5] Distribution Based Scaling

Air quality information on the Pan-European scale is provided for 3 scenarios covering NO_2, O_3, SO_2 and PM_{10}.

The visualisation on the Pan-European scale provide the possibility to see the temporal evolution presented either as maps of 10-year averages or as time series from user selected locations presented as 10-year, 1-year, monthly and daily averages (Figure 4). The same information can be exported in CSV format.

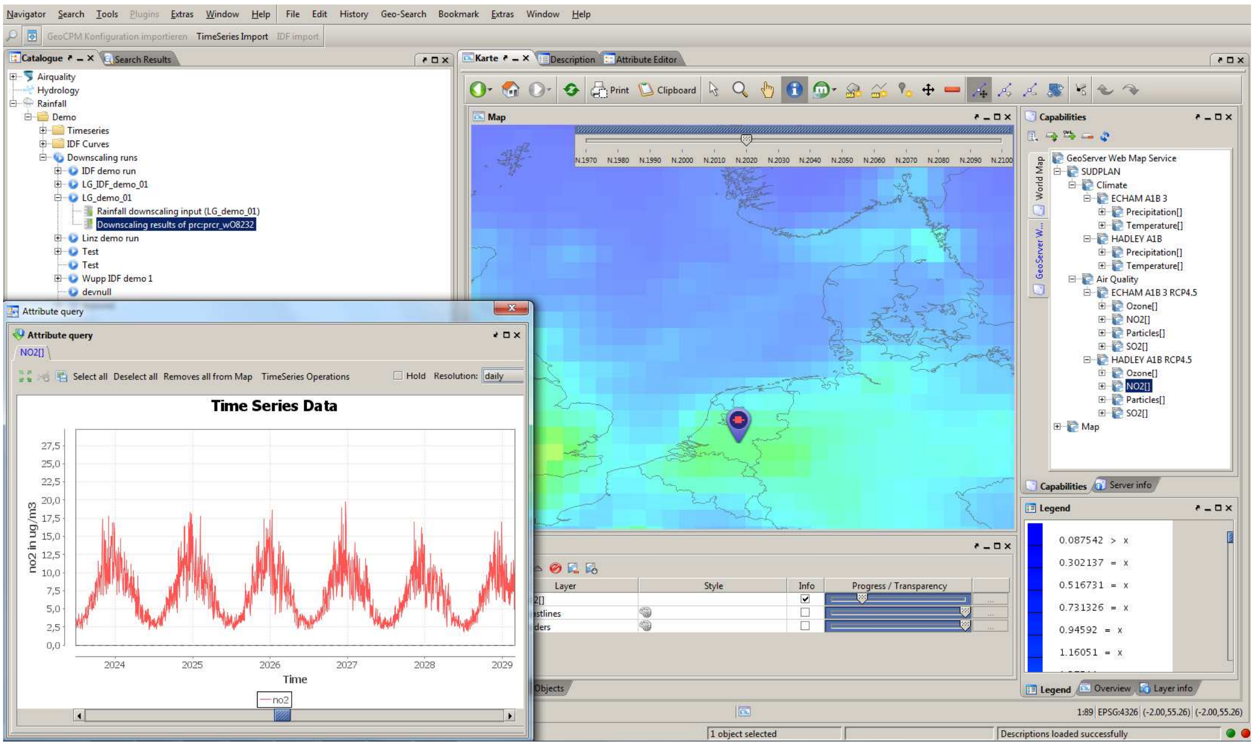

Figure 4: Example of visualisation of spatial distribution of 10-year averages and time series of daily NO_2 levels simulated with a HADLEY climate scenario, covering the period 1960-2100, as a base.

In addition to the visualisation on the Pan-European scale, SUDPLAN Common Services also include three downscaling models. We will here shortly describe the required input and the resulting output of those models.

Intense rainfall

In order to downscale precipitation, there are two alternatives for input: continuous high-resolution time series or IDF-values (Intensity-Duration-Frequency, representing short-term extreme statistics). These inputs represent the type of data used in storm water modelling and system design. In both cases, downscaling is based on the general Delta Change method, where historical observations are modified in line with expected future changes.

In time-series downscaling short-term precipitation from climate scenarios are analysed in order to estimate future changes associated with different intensity levels in the frequency distribution. The analysis is applied to time series of 30-min precipitation in one reference period (for which is attributed the statistical characteristics of the measured precipitation time series) and one future 30-year time period, both specified by the user. Time series from five model grid points surrounding the desired location are analysed in order to reduce statistical uncertainty of the projected future precipitation time series. In addition, an option to use frequency adjustment has been implemented. With this last option not only the rainfall intensity frequency distribution will be in line with the expected future changes, but also the frequency of occurrence of dry and wet (i.e. rainy) periods. This is based on removal or multiplication (‘cloning’) of representative rainfall events in the historical series, to adjust the frequency of occurrence to fit the expected future occurrence.

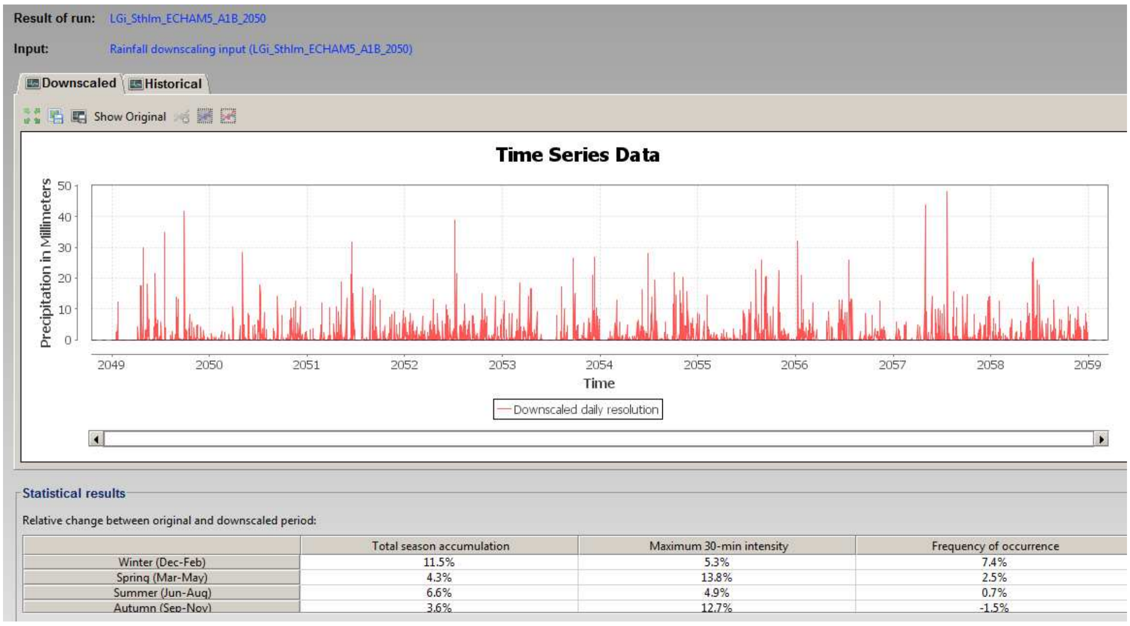

Figure 5: Example of output from rainfall time series downscaling

Figure 5 shows an example of output from the model, here as daily averages of rainfall. It is also possible to visualise and export model output with the same temporal resolution as input data, i.e. also asynchronous data from a gauge of the tipping-bucket type.

The second input alternative is a table of IDF values from the location of interest. The IDF downscaling is based on extreme value analysis of annual rainfall maxima of different durations using the Generalized Extreme Value Type 1 (EV1 or Gumbel) distribution. For the selected climate scenario, the analysis is applied to time series of 30-min precipitation in one 30-year reference period, which represents the period used in IDF analysis and for which is attributed the IDF statistical characteristics, and one future 30-year time period, specified by the user. In the same way as for time series, downscaled output from five model grid points surrounding the desired location are analysed in order to reduce statistical uncertainty. Output from IDF downscaling is exemplified in Figure 6.

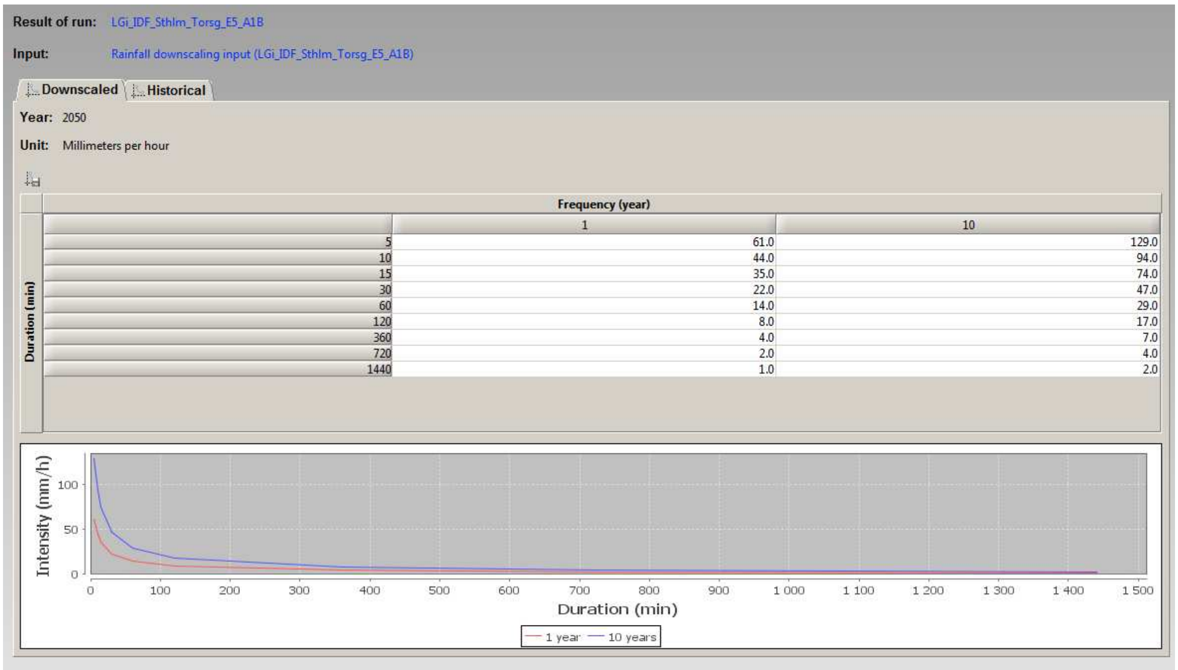

Figure 6: Example of output from rainfall IDF downscaling

Hydrological downscaling

For hydrology the local adaption is best described as improved runoff information due to local calibration of the hydrological model. From a technical perspective this is not downscaling, but from the users perspective we get the local adaption as desired. The Pan-European model data is calibrated to optimize runoff all over Europe. When optimizing model output at a specific location, only the upstream catchment area is of interest. With input in the form of time series of daily river discharge at the point of interest, the first step is an auto-calibration in order to yield a model output as close as possible to the input Q data. With this re-calibrated model, only consisting of upstream sub-basins, it is possible to apply the forcing of a selected climate scenario, yielding as output the projection of the hydrological variables up to the year of 2100. It should be stressed that hydrological simulations do not use direct output from the regional climate model, instead DBS-corrected (Distribution Based Scaling) precipitation and temperature are used as forcing. The DBS-corrected data are available for all Europe (Table 2).

Figure 7 shows an example of output from the hydrological model with the two forcing time series DBS-corrected temperature and precipitation plus simulated specific runoff, river discharge (Q), relative soil moisture and groundwater.

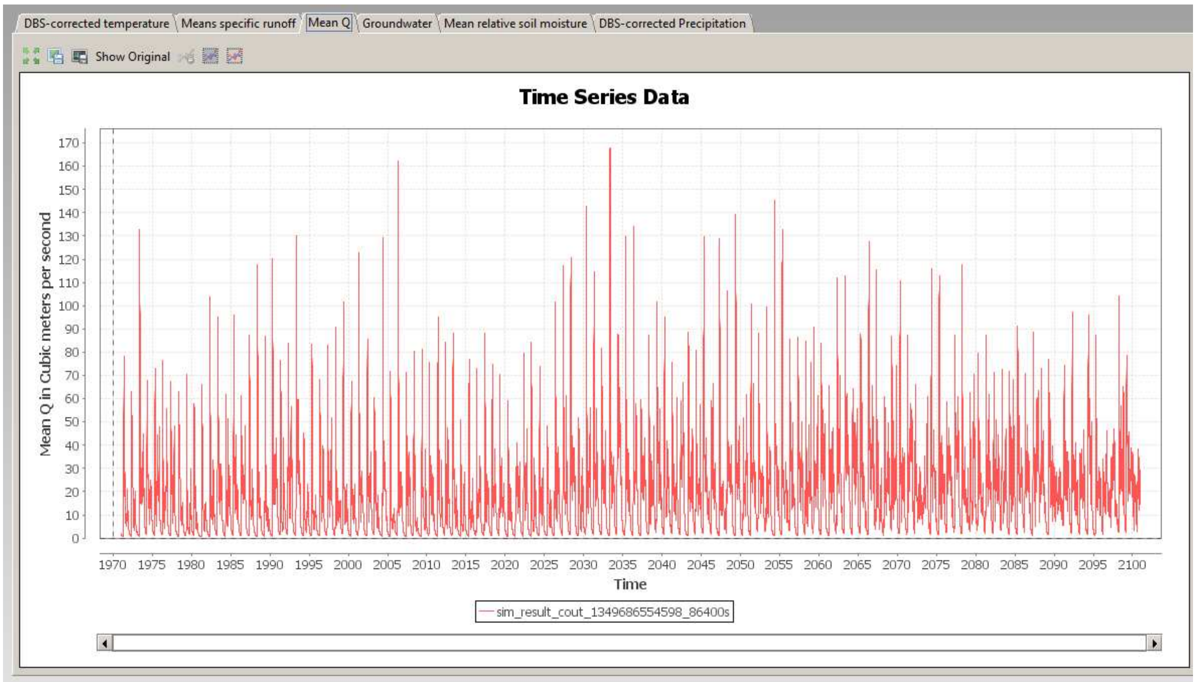

Figure 7: Example of output from hydrological downscaling

Air Quality

The air quality downscaling is fully dynamic as it is based on a high-resolution, additional simulation with the dispersion model over a city, using the Pan-European air quality model output as boundary conditions (in air quality modelling the procedure is referred to as “nesting”). The improvement will completely rely on improved details in emission information. The user input is gridded annual averaged emissions of NO_x, NH_4, VOC, CO, SO_2 and PM_{10}. The emission upload wizard also allows the user to upload time variation tables for each emission grid. The air quality model of Common Services can also handle point and line sources, but then the emission database must be operated through an external GUI, the Airviro[6] system. Output from the model is surface concentrations of NO_2, NO_x, O_3, SO_2 and PM_{10}. Figure 8 shows two of multiple possibilities to visualise 2D air quality grids.

[6] Airviro is an air quality management system developed by partners SMHI and Apertum (http://www.smhi.se/airviro)

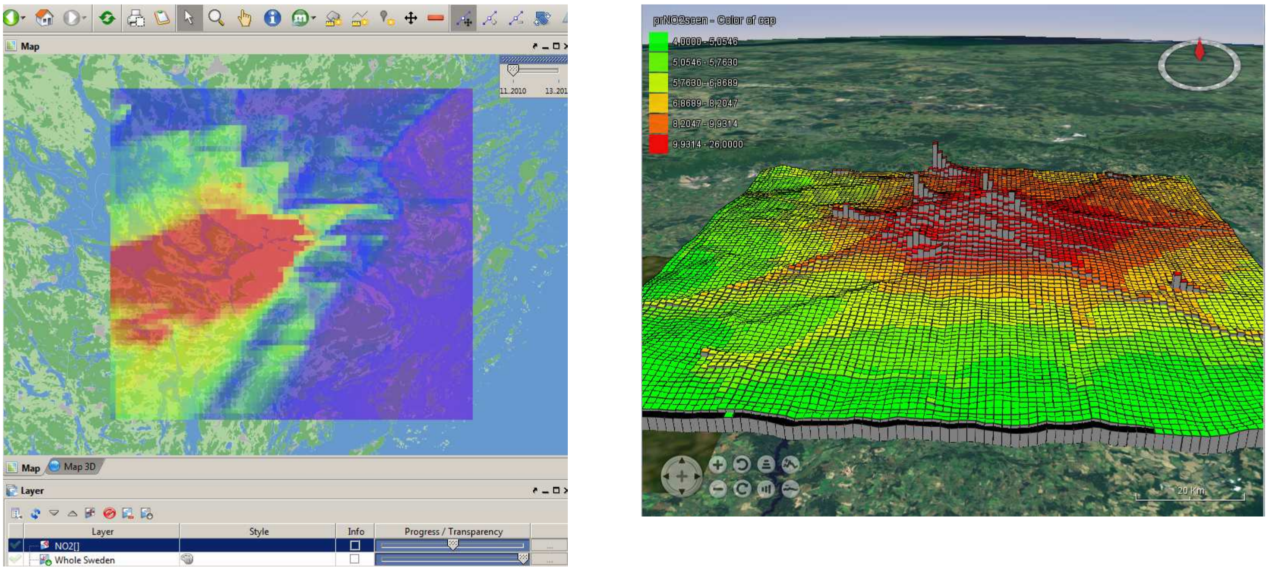

Figure 8: Example of output from air quality downscaling (left 2D presentation, right 3D presentation)

In what follow we will shortly describe the architecture of the Common Services. The technical structure is illustrated in Figure 9.

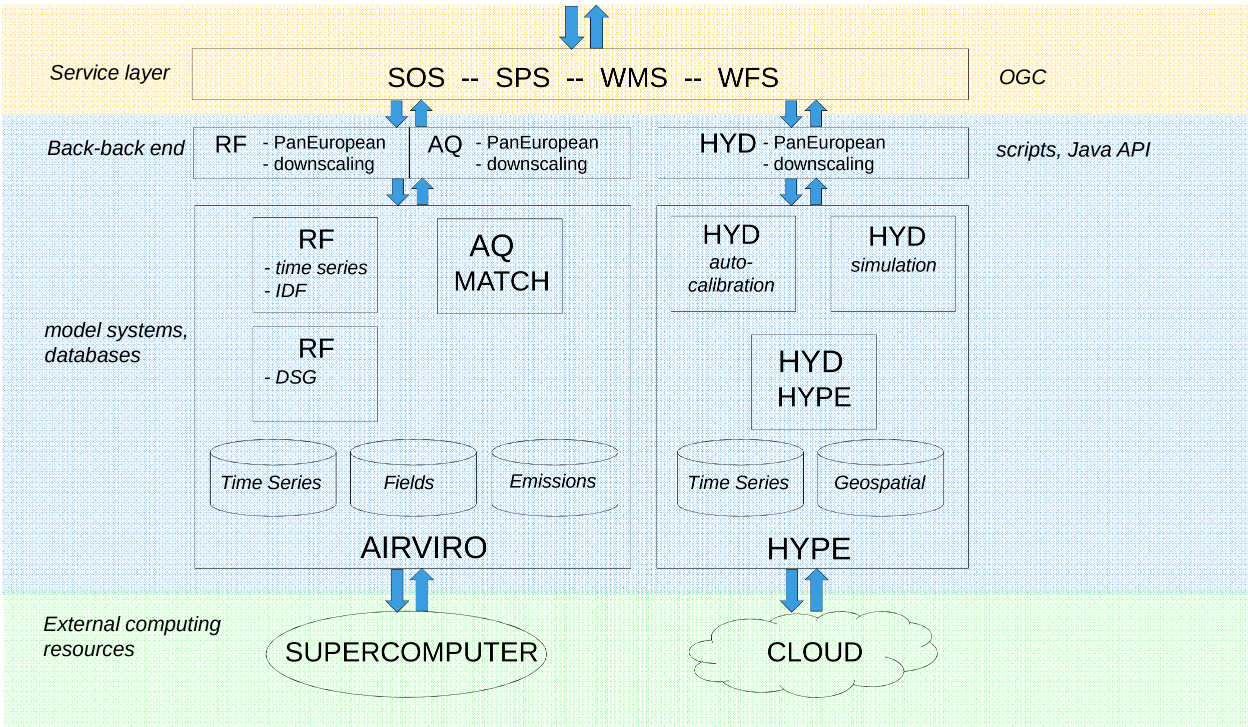

Figure 9: Common Services layered architecture

The rainfall and air quality downscaling, together with the corresponding Pan-European climate- and environmental information, have been implemented in an existing software, the Airviro system. Input and output data are either pointwise time series or gridded time series. The hydrological data consist of pointwise time series and irregular polygons representing catchments and sub-catchments, managed through the existing HYPE[7] model system. Therefore the back-back end solutions are also split in two parts. The service layer does however streamline the communication to all Common Services, so that external user will only have to follow the OGC[8] standards of four services SOS[9], SPS[10], WMS[11] and WFS[12] in order to establish communication.

4.1.3.3 Scenario Management System

The Scenario Management System (SMS) constitutes the core of the SUDPLAN system. It is built up by three distinct Building Blocks **SMS Framework**, **Model as a Service Integration,** and **Advanced Visualisation.** The SMS can be seen as a generic integration platform that will be able to facilitate climate change induced urban development planning in any city in Europe. The goal has been to provide a universal, flexible and adaptable planning tool, designed with a layered structure (Figure 10).

The top-level layer, the SUDPLAN Application itself, is the result of an extension, customisation and configuration of the underlying SMS. The SMS comes with everything necessary to provide common scenario management tasks including data integration, model management and execution, basic and advanced visualisation, and comparison of various temporal and spatial data sets, etc. It therefore relies upon standard services for data access and model management and thus greatly facilitates the task of integrating new models and data sources. Consequently, the same mechanisms used for interfacing the SUDPLAN Common Services with the SMS can be used for local model and data source integration.

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[7] HYPE (Hydrological Predictions for the Environment) is a hydrological model developed by partner SMHI and available as open source on http://hype.sourceforge.net)
[8] Open Geospatial Consortium is an international industry consortium developing interface standards for GIS applications.
[9] Sensor Observation Service
[10] Sensor Planning Service
[11] Web Map Service
[12] Web Feature Service

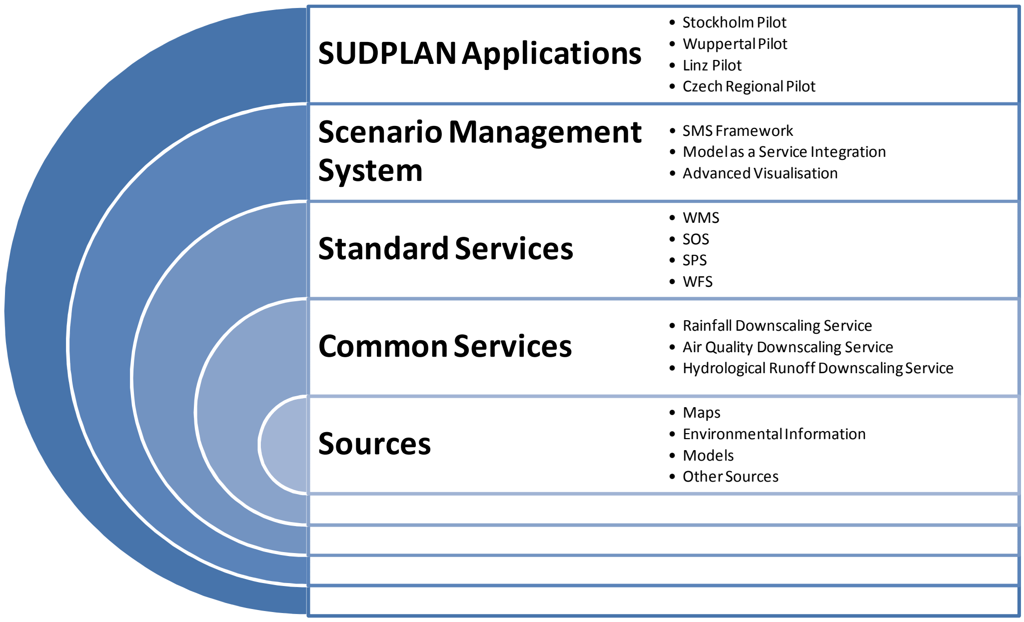

Figure 10: SUDPLAN Layered Architecture

The system is based on cids (http://www.cismet.de/cidsReadme.html), an open source toolkit for the management and integration of complex, heterogeneous, multi-domain, multi-use data of both a temporal and spatial nature. It has earlier been used by cismet, the developer of cids, in the ICT context, including FP5 and FP6 projects.

As shown in Figure 10, several services specified by the Open Geospatial Consortium (OGC) are supported by the SMS: Sensor Planning Service (SPS), Sensor Observation Service (SOS), Web Map Service (WMS) and Web Feature Service (WFS).The implementation of SOS and SPS related software is based on the Time Series Toolbox (TS-Toolbox) API from partner AIT. The TS-Toolbox API provides the means to conveniently deal with arbitrary time series.

The advanced visualisation component is based on World Wind SDK[13], a free and open source Java-API for a virtual globe released under the NASA Open Source Agreement (NOSA). World Wind provides many features for displaying as well as interacting with geographic data and representing a wide range of geometric objects. Because of many features already provided by World Wind's virtual globe we were able to come up with a more general concept in order to cope with pilots' visualisation needs. After the integration of the World Wind SDK and the synchronization with the SMS we developed a new visualisation wizard called VisWiz. The idea of VisWiz is to provide a means to support the user in selecting a suitable and state-of-the-art 3-D visualisation technique both in the sense of scientific visualisation and information visualisation. VisWiz focus on the independence of the provided GIS data from the visualisation.

[13] World Wind SDK is available at http://worldwind.arc.nasa.gov/java/

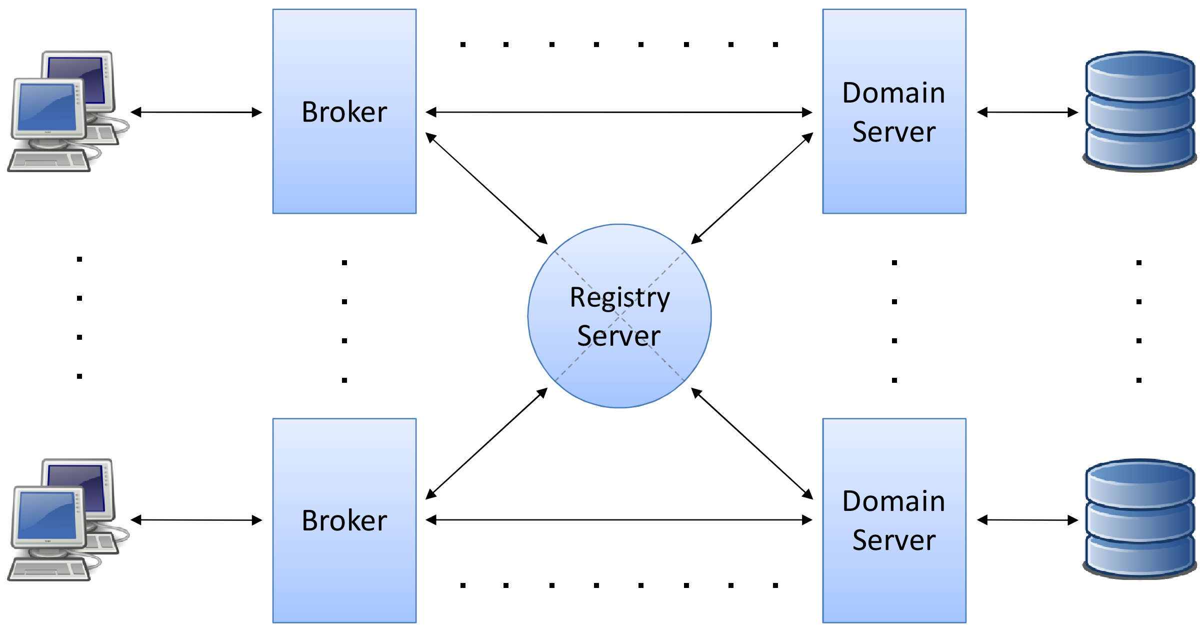

Figure 11: SMS Framework client-server Architecture

Figure 11 shows that the SMS Framework is based on a client-server architecture in which an arbitrary number of client instances and server components co-exist in a service network, thus ensuring scalability and reliability. The main building blocks of the SMS Framework are the Navigator (client), the Kernel, and a set of system management tools. The building blocks and the components are shown in Figure 12.

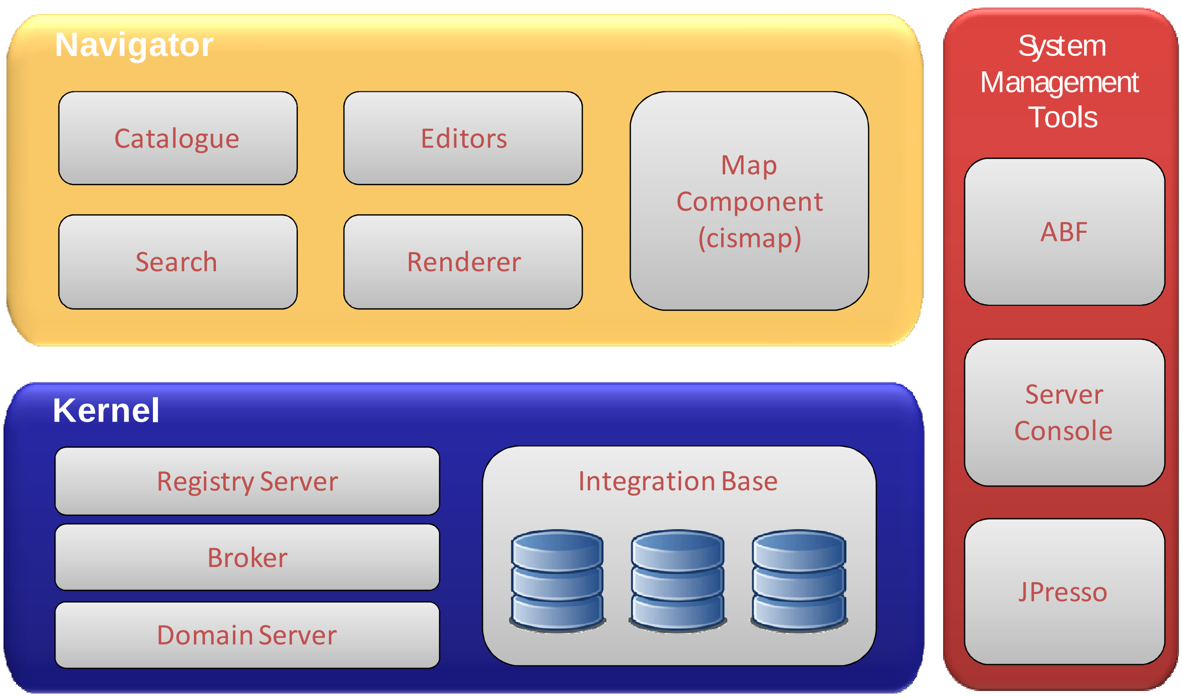

Figure 12: Building Blocks of the SMS Framework

The current version of SMS related software can be found at:

http://www.sudplan.eu/Results/Software/sudplan-software-1.20201

Figure 13 shows an example how the SMS can be used to visualize and analyze simultaneously spatial and temporal aspects of environmental information.

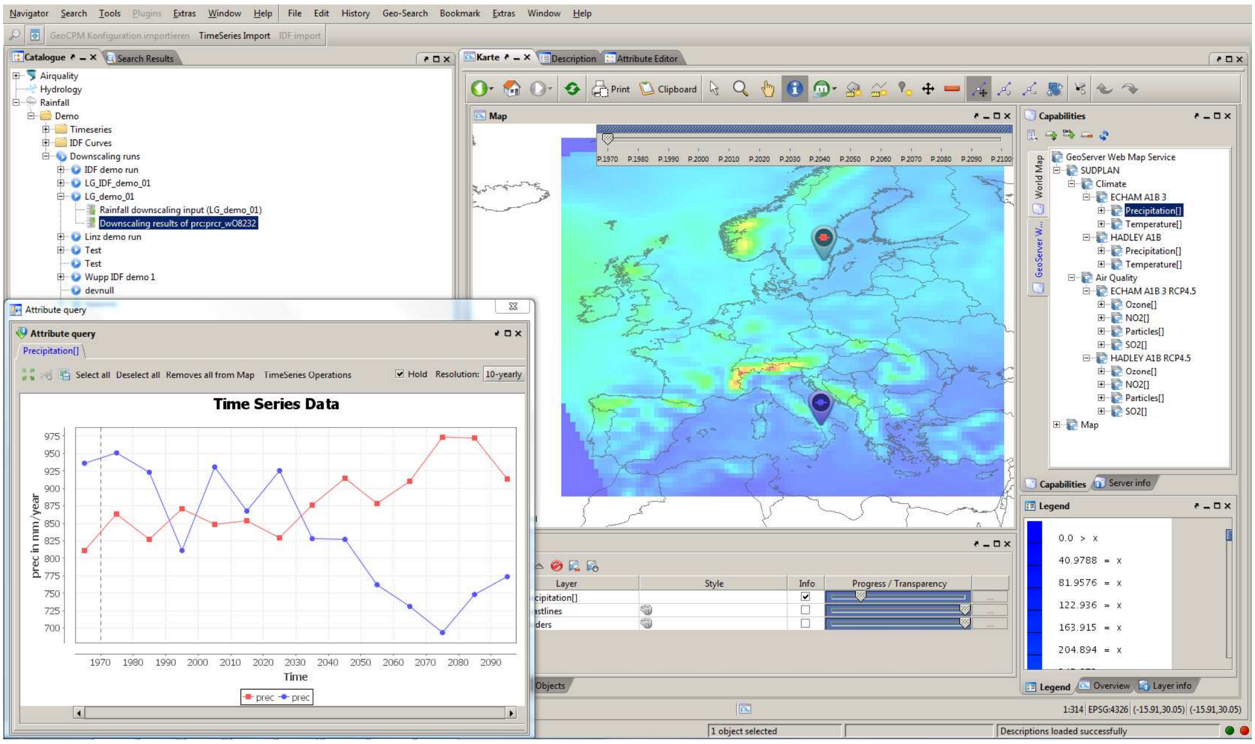

Figure 13: SMS used to explore Pan-European information of future precipitation

4.1.3.4 How SUDPLAN information enters the planning process

The SUDPLAN tool integrates both Common Services downscaling models (regional/urban scale) and more detailed local models that operate with very small scale features, down to centimetres. The models are either responding directly to environmental input like precipitation and temperature (the Rainfall and Hydrological applications) or they are more indirectly influenced by climate (air quality application).

Infrastructure projects involve a planning process where the environmental conditions must be assessed, either because they determine the project design (e.g. dimensions of rainwater runoff pipes) or because the project itself may impact the environment (spill of polluted water, exposure to air pollution). The latter assessments are named Environmental Impact Assessments (EIA) and are often regulated, e.g. in Sweden the transport sector follows a manual for how and when assess the impact of planned road and rail projects. The urban planning involve different stages, starting as a part of a Master plan or a Strategic plan for how the city should evolve during coming decades. The spatial scale covered may be urban or regional. At a later stage specific projects come into the feasibility assessment, where different scenarios can be compared in different aspects, including the consequences for the environment. When location and principal structure of the project has been cleared out, it is time for the design phase where model simulations necessarily goes down in detail and scale. EIAs are often required also during the project construction and also with follow-up afterwards, to confirm that the planning was made in a relevant way. The two time/scale/planning phase lines in Figure 14 illustrate this procedure.

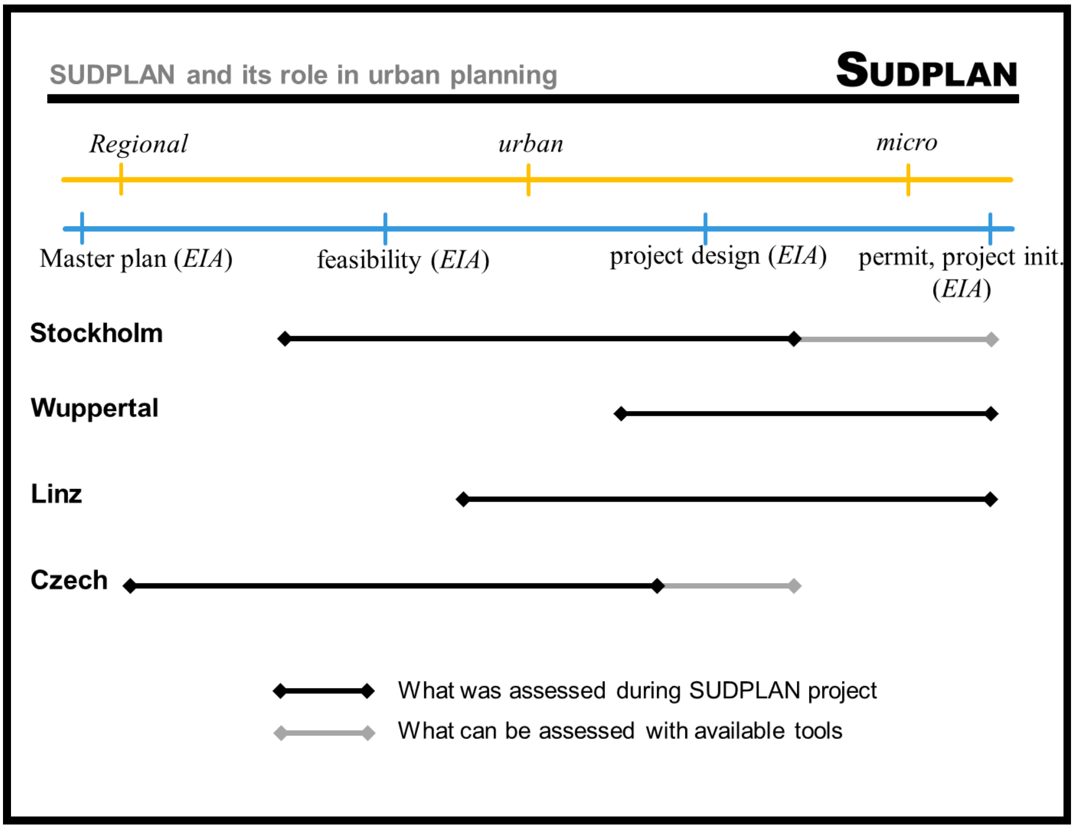

Figure 14: Principles for how SUDPLAN entered the planning processes in the project pilots.

The Stockholm and the Czech pilots both focused air quality and used the Common Services downscaling model to assess future air quality as a consequence of local urban scenarios and with climate change taking into account. Stockholm went more into detail, as the planning of a new road project was in a rather advanced state. Stockholm also disposes an air quality modelling system for the local scale, which was used – outside the SUDPLAN project – to assess different technical solutions of two possible road scenarios.

The two pilots which require information on future rainfall intensities, Wuppertal and Linz, both use detailed models for drainage systems. The SUDPLAN application in Wuppertal also includes a very high resolution surface runoff model. This allows their scenario modelling to go very far into the microscale (spatial resolutions down to centimetres) and assess small design details of possible changes in the city infrastructure (road kerbs, street levels etc.).

Figure 15 shows the step-by-step assessments in Wuppertal, where SUDPLAN modelling comes in whenever there are risks for flooding. The tool is used to find the appropriate solution among different measures that can be taken. With the SUDPLAN climate scenarios, they may assure a sustainable solution that avoids flooding also in the future.

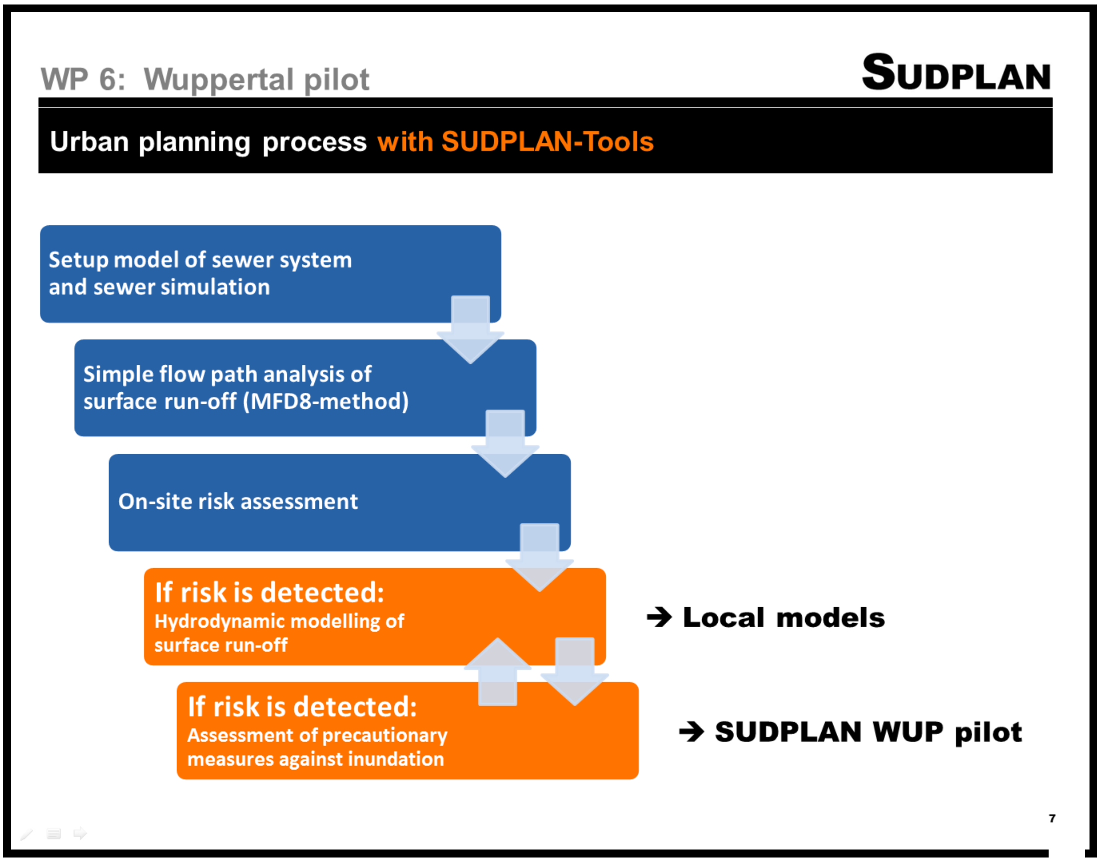

Figure 15: Principles for how SUDPLAN is used in the Wuppertal planning to avoid storm water flooding.

Similar schemes like the one in Figure 36 characterise the use of SUDPLAN in the Linz pilot. The other two pilots, which focus on air quality impact assessments, uses SUDPLAN Common Services earlier in the planning process. The experience gained by project pilots can be used to design the future use of the SUDPLAN tool in European cities and regions. There are also synergies effects if

SUDPLAN is used by a specific city for more than one application, involving both water and air pollution.

4.1.3.5 Wuppertal Pilot

The city of Wuppertal, a town with approximately 350,000 residents, is the biggest town in Germany that is situated in hill country (from 98 to 353 m above mean sea level). It is located in the steep, narrow, and long valley of the Wupper river. There are several creeks on both sides of this valley that open into the storm water sewage system before they finally end in the Wupper. During a heavy rainfall event the city's storm water sewage system is quickly blocked by those swollen creeks causing the precipitation to run off on the surface. The storm water run-off may thereby affect valuable public infrastructure and private property. This is a major concern to the city managers. Due to the complex geography it is completely unpredictable where a heavy rainfall event might occur and therefore unknown whether there will be flooding and where it will run off.

Up to now the mid- and long-term planning of the storm water sewage system has been accomplished with iterative model runs of a hydrological model (for the creeks) and a hydrodynamic model (for the sewage system). This planning process is called 'Generalentwässerungsplanung' (GEP), what could be translated as 'General Drainage Strategy'. Wuppertal's first main objective is to **expand the GEP**: the modelling of surface run-off after heavy rainfall events should be integrated into the process. To achieve this goal, a hydrodynamic model should be used to **detect the critical spots** (high risk of flooding plus valuable and vulnerable facilities). This is the second main objective.

Wuppertal's third main objective is to **mitigate the risk of flooding** for the detected critical spots. The traditional strategies to achieve this are either the enlargement of the profiles of the sewage system or the construction of retention basins. Given these two options the potential needs for investments would be immense, considering that the city copes with water run-off from 350 kilometres of creeks (over 800 creek sections) and 650 kilometres of sewage channel system. An alternative and much more cost-efficient strategy is to look for localised planning options which are likely to prevent damage. Examples for such structural measures are the alteration of street profiles by means of higher road kerbs or the installation of stationary (or mobile) walls. So Wuppertal's fourth main objective is to **find the most cost-efficient measures for the flood risk mitigation** for each critical spot. These measures shall give a higher probability to prevent damage and should yet be practical to implement, including being capable to cope with the ever growing financial constraints of the city.

The fifth main objective is to provide the responsible planners and hydrological modellers in Wuppertal with a tool that enables them to simulate a multitude of modelling experiments with the model component for the surface run-off, both to detect the critical spots and to simulate the effects of different structural measures at the critical spots. The tool should be able to store the parameters and results of such a model run and to visualise the results. The SUDPLAN project has provided such a tool **–** the **Scenario Management System (SMS)**.

Local models

In the SUDPLAN Wuppertal pilot GeoCPM is used to calculate the stormwater surface run-off in model runs defined with the SMS. The most complex input parameter for such a model run - besides the simulated precipitation data - is an optimised high-resolution digital elevation model (DEM), the so-called ‘calculation model’. GeoCPM expects this in the form of a triangulated irregular network (TIN). The labour-intensive step in creating a calculation model is to define all the relevant man-made breaklines like the exterior walls of buildings (‘building breaklines’) and road kerbs or similar vertical structures (‘road kerb breaklines’).

To achieve further accuracy GeoCPM is often used in conjunction with DYNA. DYNA can perform hydrodynamic calculations of sewer systems and thus requires a modelled sewer system as an input. The WSW and the City of Wuppertal are using DYNA for several years now, therefore a set of DYNA input parameter files is available that describes the current state of Wuppertal’s sewer network. It consists of the main parameter file DYNA.EIN and two more optional files. These files can be used as initial point for all combined model runs of GeoCPM and DYNA.

The modelling of the surface run-off during heavy stormwater events has been introduced into the continuous planning process of Wuppertal’s sewer system, called ‘Generalentwässerungsplanung‘ (General Drainage Strategy). This is an important achievement, because it implements the workflow the SUDPLAN SMS covers.

Common Services input to local models

The local models GeoCPM/DYNA require a description of a typical rainfall event as input, showing how precipitation intensity varies over 1-2 hours. By selecting the storm to be of the Euler type, it is possible to generate a storm event (Figure 16) from an IDF table, either calculated from existing precipitation data or from Common Services output for a future climate scenario (see Section 3.2).

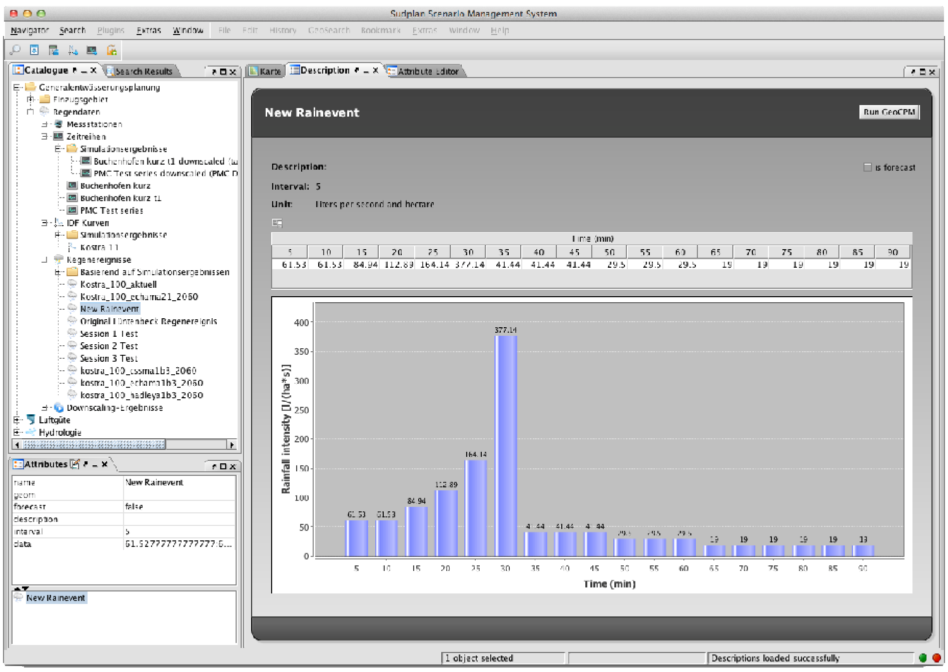

Figure 16: SMS used to generate a storm event

By running a series of scenarios, with different structural measures made in model topography, it is possible to identify a solution that avoids critical flooding. An example of model output from a scenario simulation with Wuppertal local models is given in Figure 17.

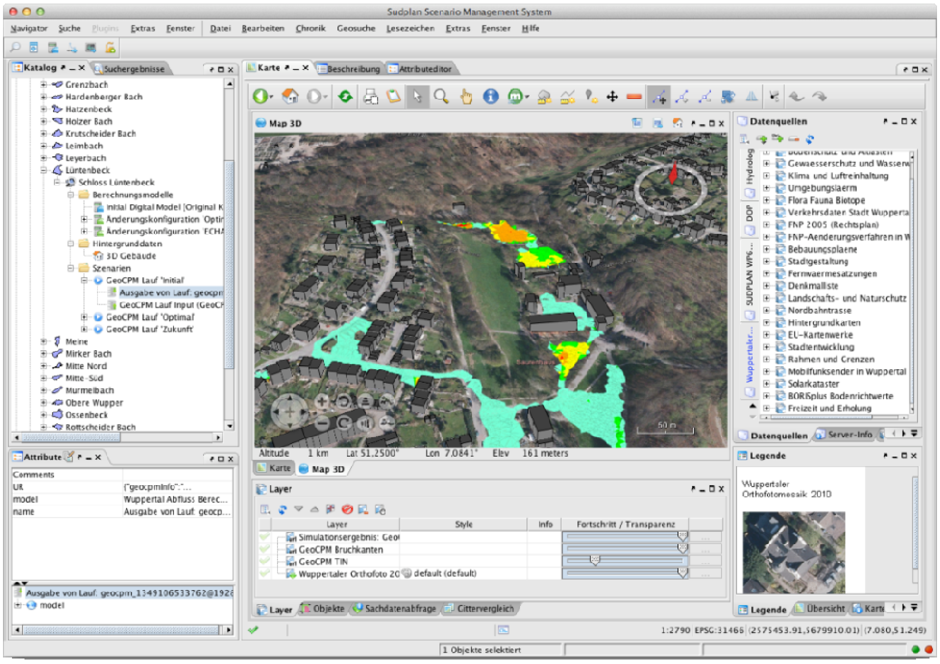

Figure 17: 3D visualisation of maximum water levels as given by the Wuppertal local models.

4.1.3.6 Linz pilot

Urban drainage systems form a valuable backbone of urban infrastructure. On average, it is estimated that the value of the urban wastewater system is about 300 Mio € per 100.000 inhabitants. In many European cities waste water and storm water are drained in one sewerage system ("combined systems"). Thus the urban wastewater system is very vulnerable to potential climate change impacts, particularly to a potential increase of extreme flood events and more spilled out pollution loads from the sewerage system to receiving waters. Due to the hydraulic limitation of waste water treatment plants (WWTPs) it is not possible to treat the whole amount of drained water at WWTPs; thus the runoff in combined sewer systems has to be either discharged at combined sewer overflows (CSO) into receiving waters or temporarily stored in reservoirs. CSO facilities can be designed with a retention volume ("CSO tank") in order to mitigate overflow events during heavy rains. Besides CSO tanks also show considerable capacities to hold back the TSS (Total Suspended Solids) and COD (Chemical Oxygen Demand) loads in waste and storm water which are the key parameters to describe and quantify the transported pollution loads in sewer systems.

To limit the spilled out pollution loads from combined sewer systems into receiving waters a new guideline, the so called ÖWAV Regelblatt 19, was introduced in Austria in 2007. The guideline defines the CSO efficiency η of combined sewer overflows as an indicator for CSO pollution. Thereby η is defined as the part of the surface runoff treated at the WWTP and is expressed in percentage of the total rainfall runoff in the whole catchment area which is drained to the WWTP.

The guideline distinguishes between two different kinds of CSO efficiency rates, one for dissolved pollutants (η_d) and one for particulate pollutants (η_p) and defines required percentage values for each of them. The required percentage values depend on the dimension of the WWTP and the rain characteristic $r_{720,1}$, based on the German ATV A121 of the investigated catchment.

The current CSO efficiency rates which have to be higher than the required values can be calculated by applying rainfall-runoff transport models. The calculation of η should be done as an average over a long-time period of at least 10 years. Hence this requires long-term simulation by either hydrological or hydrodynamic models. Temporal resolution of rainfall data should be 10 minutes or higher. For the Linz pilot catchment area an aggregated hydrodynamic model with the software SWMM 5 was used.

Figure 18 shows model representation of the Linz catchment in the SWMM 5 modelling software including subcatchments, aggregated main sewer conduits, overflow weirs and storage tanks. The subcatchments are represented according to their actual geometry and all data is geo-referenced.

Figure 18: Linz catchment representation in SWMM 5

Table 3 shows different SWMM simulation results of historical and future predicted model runs based on 4 different climate change approaches and in comparison with the required CSO efficiency rates defined in the Austrian guideline. Figure 19 shows a visualisation of the CSO overflow volumes at each CSO in the catchment area and Figure 20 the corresponding calculated and required efficiency rates for this model run.

Table 3: Required and calculated CSO efficiency rates for historical and predicted rainfall time series

Time series	Annual mean	r_{720_1}	$\eta_{d,req}$	$\eta_{d,act}$	υ_d	$\eta_{p,req}$	$\eta_{p,act}$	υ_p
	mm/a	mm	%	%	-	%	%	-
Historical	849.7	35.1	57.4	67.3	1.17	72.4	73.5	1.02
ECHAM5 (E)	941.2	39.2	55.4	63.9	1.15	70.4	70.8	1.01
ECHAM5-FA (E-FA)	941.6	40.8	54.6	64.2	1.18	69.6	71.1	1.02
HADLEY (H)	933.8	38.7	55.7	64.5	1.16	70.7	71.3	1.01
HADLEY-FA (H-FA)	932.8	40.9	54.6	64.1	1.17	69.6	70.9	1.02

For the calculation of the CSO efficiency for particulate pollutants (η_p) the estimation of the sedimentation efficiency rates in the installed CSO tanks is crucial.

Since about 60% of the annual average overflow volume of the Linz catchment is spilled at the primary clarifiers at WWTP Linz which serve in a way also as CSO tanks a sensor network was installed and operated to estimate the occurring sedimentation efficiency rates in this CSO facility.

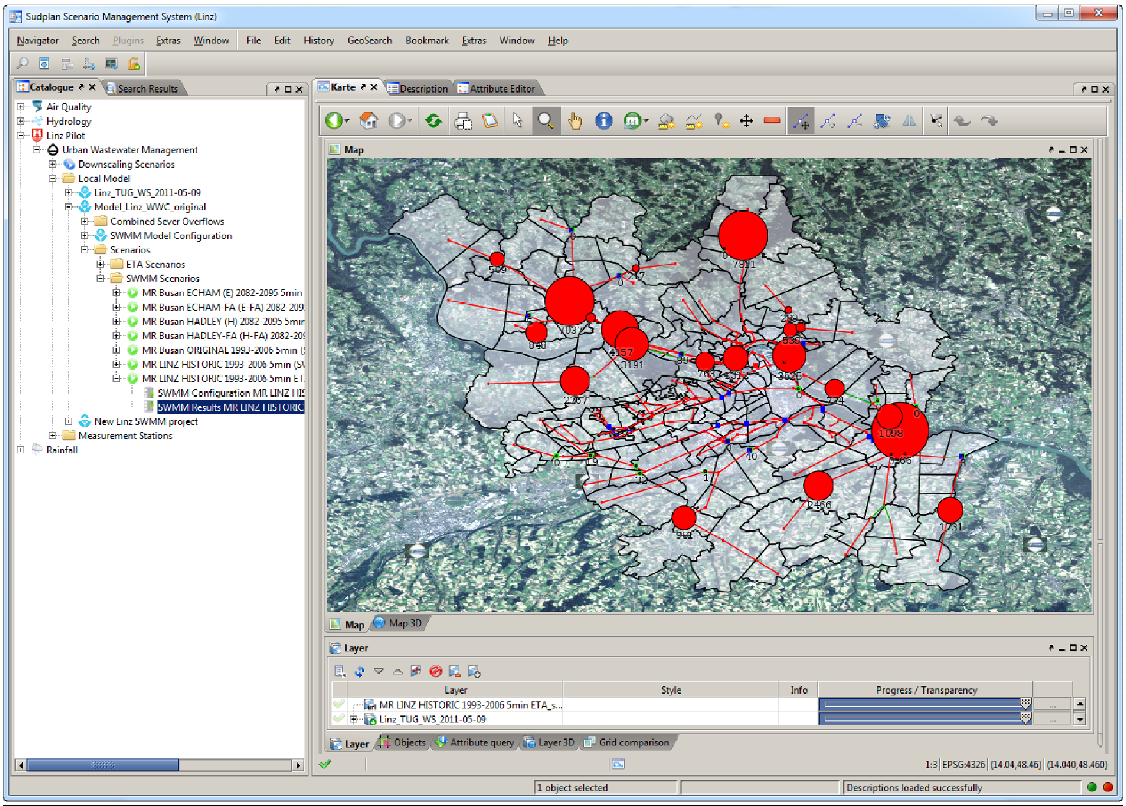

Figure 19: Visualization of all CSO overflow volumes of a model run in a WMS layer

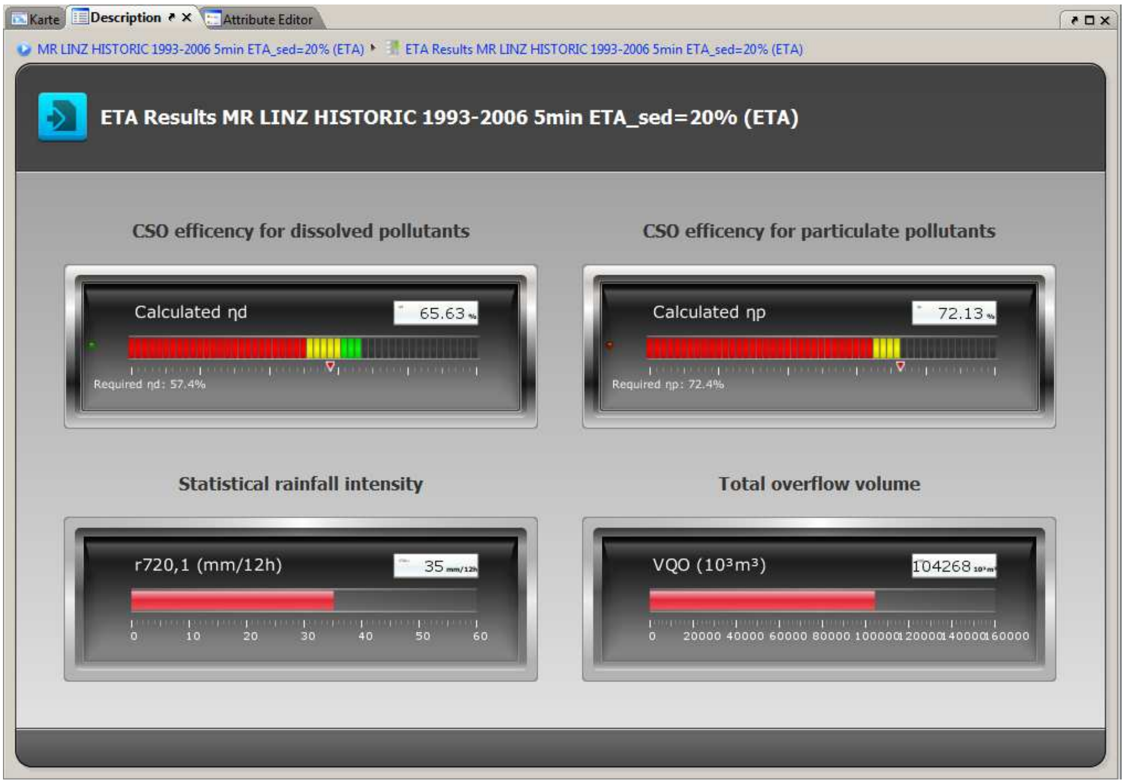

Figure 20: View output of efficiency calculation

4.1.3.7 Air Quality: Stockholm and Prague

The Stockholm case

The Swedish pilot partner Stockholm-Uppsala Air Quality Association (SULVF) is managing the air pollution issues for a large area covering 6 counties in Sweden (300 km x 400 km) with around 3.5 million people (35 municipalities; about 40% of the total population of Sweden).

Air pollution is already today a critical issue in Stockholm and the European Commission has had to start infringement proceedings against Sweden for failing to comply with the EU's air quality standard for dangerous airborne particles known as PM10. Stockholm is one of the Swedish cities that do not meet EU standards for PM10. Stockholm city is further developing the action plan to reduce PM levels, and there are concerns that climate change may bring about effects on air quality that will require special attention and other actions than those prioritised today. The Stockholm pilot will use the tools developed in the SUDPLAN project to provide local authorities and institutions in the Stockholm-Uppsala region with levels and trends in air pollution during the coming decades, including the effect on air quality of both local emission scenarios (result of urban planning) and climate change.

The most severe health effects come from exposure to ozone and PM10. Both of these pollutants are, to a major part, originating outside Sweden and transported with the wind from the European continent. The rate at which EU will be able to control emissions within member countries will thus have important consequences for future air pollution levels in Europe.

The SULVF air quality management system for the Stockholm-Uppsala Metropolitan area, consisting of the monitoring network, an Air Quality Management System (Airviro) and all relevant information stored in Airviro databases was implemented already some 20 years ago, in support of urban planning. The system is a specialised Geographic Information System (GIS) application for air quality management and includes most of the common GIS functionality - possibilities to store different kinds air pollution data together with their spatial and temporal characteristics, powerful possibilities of data analysis such as e.g. time-series statistics of point wise and gridded field data, a great variety of presentation alternatives, interfaces to other GIS systems etc. The three areas of air quality management, measurements, emissions and modelling are fully integrated in the Airviro system. There are also local models that calculate the additional pollution experimented close to traffic, either in street canyons or along open roads.

For SULVF the SUDPLAN tool complements the existing modelling system with the following functionality:

- Possibility to scenario modelling of with inclusion of long-range contributions of air pollutants.
- Possibility to assess scenarios in a long-term perspective with changes in climate and emissions in the rest of Europe.
- Possibility to advanced 3D visualisation of all types of model results from existing local models as well as Common Services urban downscaling model

Figure 21 and 22 show the result of an assessment of expected air pollution levels in Stockholm year 2030, with and without a new planned road project. While climate change itself has little influence on future air pollution, there is a considerable effect on NO_2 level of lowered NO_x emissions in Europe.

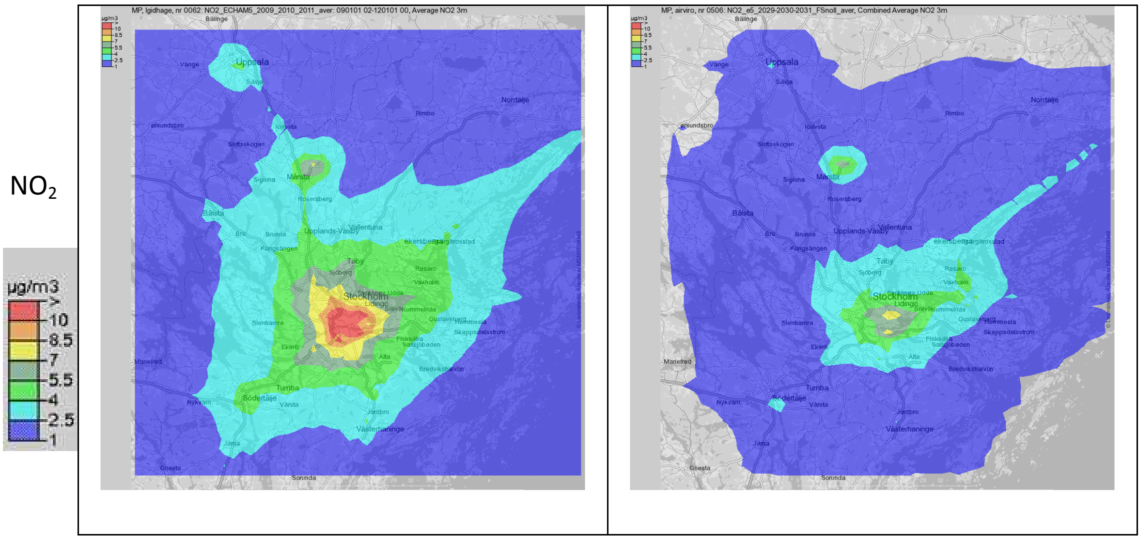

Figure 21: Simulated three-year-average NO_2 concentrations in 2009-2011 (2010 local emissions, left) and 2029-2031 (with 2030 local emissions, right) in the downscaled area over the Stockholm region, based on ECHAM5 A1B-r3 climate and RCP4.5 emissions in Europe

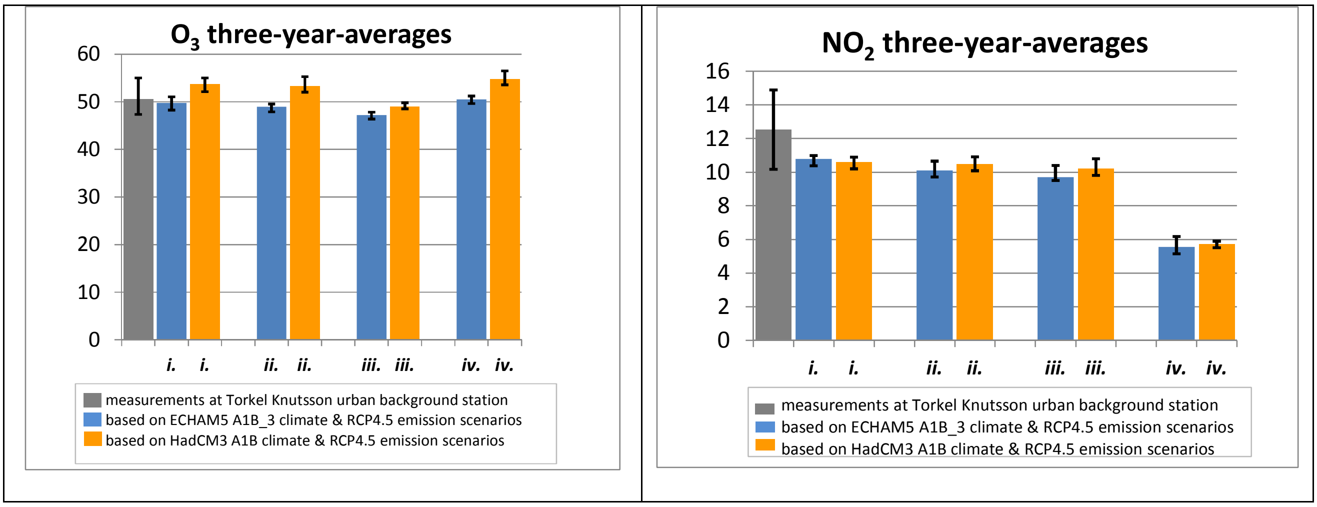

Figure 22: Observed and simulated average levels of O_3 (left) and NO_2 (right) in city centre of Stockholm, for present conditions (i.) and simulated projections of future levels with only climate change effect (ii.), including also emission changes in Europe (iii.) and adding local emission changes in Stockholm (iv.). Error bars indicate lowest and highest annual average value of the three years. Unit: μgm^{-3}.

Figure 23 show advanced visualisation of local model results, both the road link simulations of kerbside air pollution levels together with gridded surface concentrations. Another visualisation is exemplified in Figure 24, where output from a local 3D grid model has been stacked in layers.

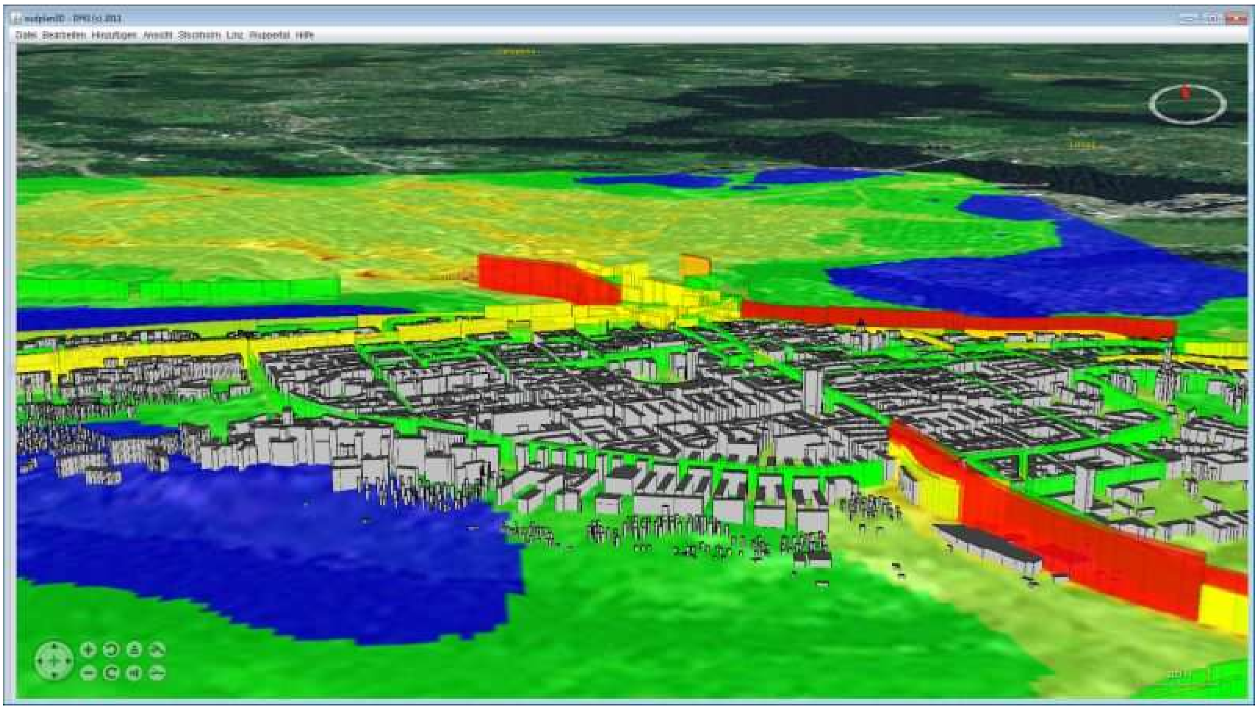

Figure 23: Combination of building model, road link data and 2D air quality results in Stockholm

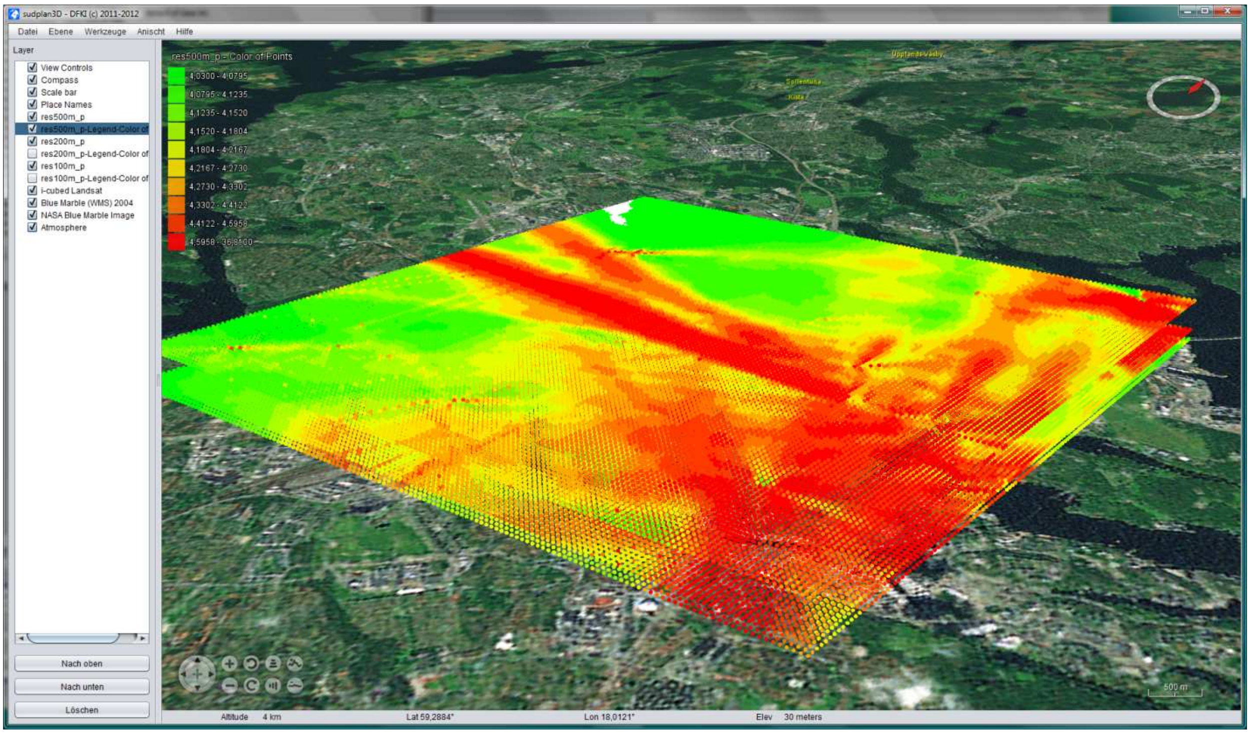

Figure 24: Example of stacking various Point Cloud layers above each other

The Czech case

The main goal of the Czech Pilot is to fill the gap in availability of advanced air quality modelling instruments in the Czech Republic, which means being able to simulate concentration of secondary pollutants and take into account climate change. The pilot has provided potential users with a modern decision support tool applicable in urban/regional development planning both at strategic level of decision-making and in the daily case-by-case practice.

An outlook of air quality in the Prague area (100 x 100 km) till 2030 was developed. Such large scale projections represent an important tool for the assessment of particular strategic scenarios of area development (e.g. variants of urban or regional development plans or of issue specific strategies like transport or energy strategies). The emission data for 2010 have been extrapolated to 2030 using the GAINS model scenario EC4MACS Baseline. Changes in expected PM10 levels 2030, as compared to 2010 levels, is illustrated in Figure 25.

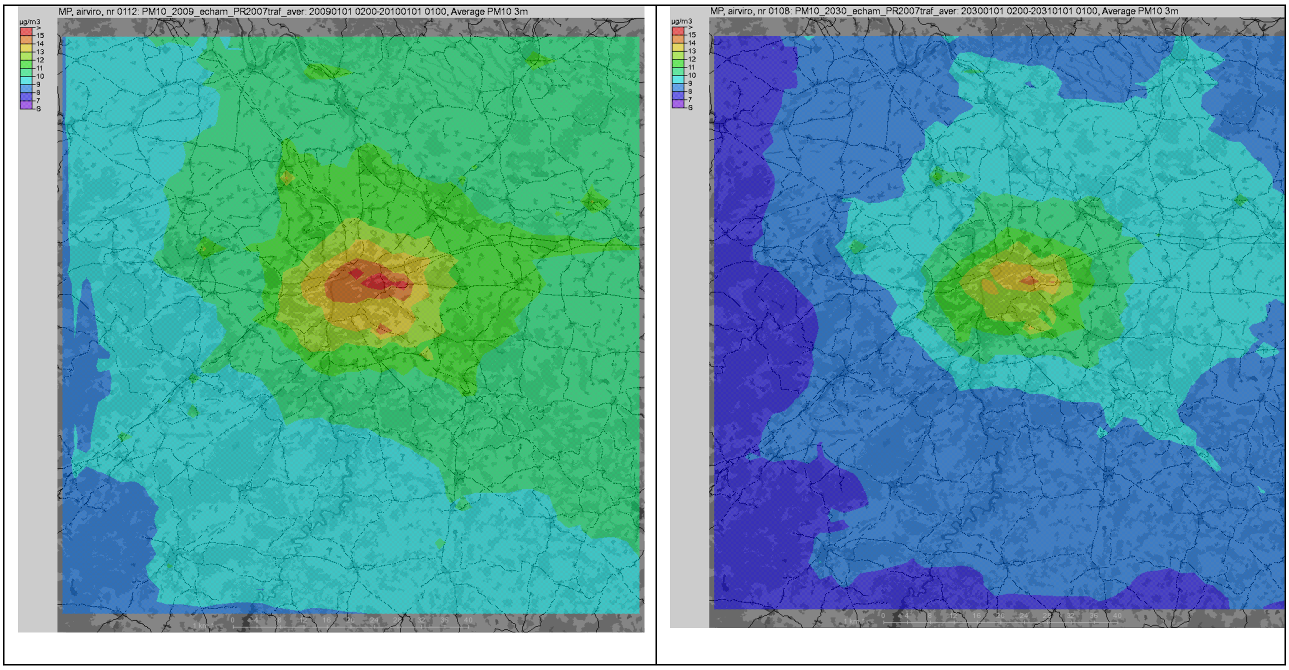

Figure 25: Annual mean of PM_{10} as simulated by SUDPLAN Common Services downscaling, representing present conditions around 2010 (left) and future conditions around 2030 (right)

Different ways of visualising the downscaled air quality results are shown in Figure 24 and 25.

The Czech pilot has used the SUDPLAN tool to assess the effects on air quality levels of three scenarios:

1. Substantial changes in operation of a large coal-fired power plant (increase of thermal input by 100 %, close-down),

2. Completion of Prague´s highway city bypass, which is currently just partly in operation, some sections are under construction while some others at the stage of planning.

3. Building up of new residential areas located in the northern and south-eastern outskirts of Prague for approx. 25 thousands new residents.

For all scenarios the baseline (nothing happens), scenario and difference layer between baseline and scenario have been calculated (Figure 28).

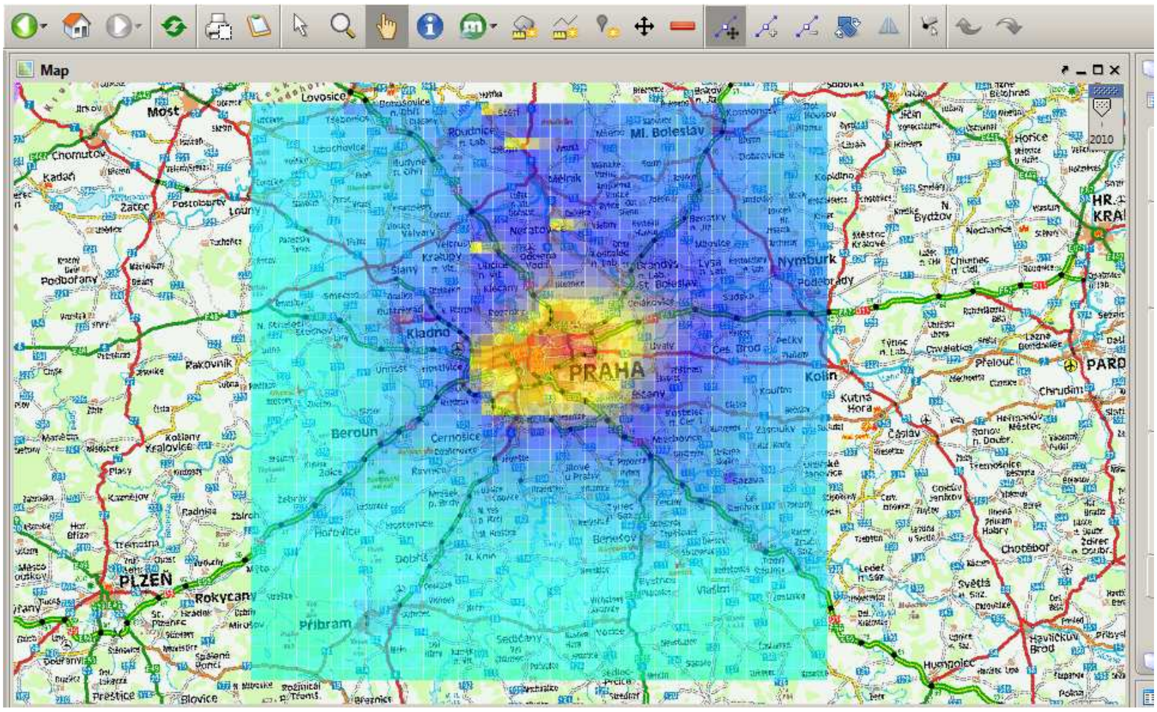

Figure 26: SMS 2D visualisation of a yearly averaged simulation of NO_2 levels for 2010.

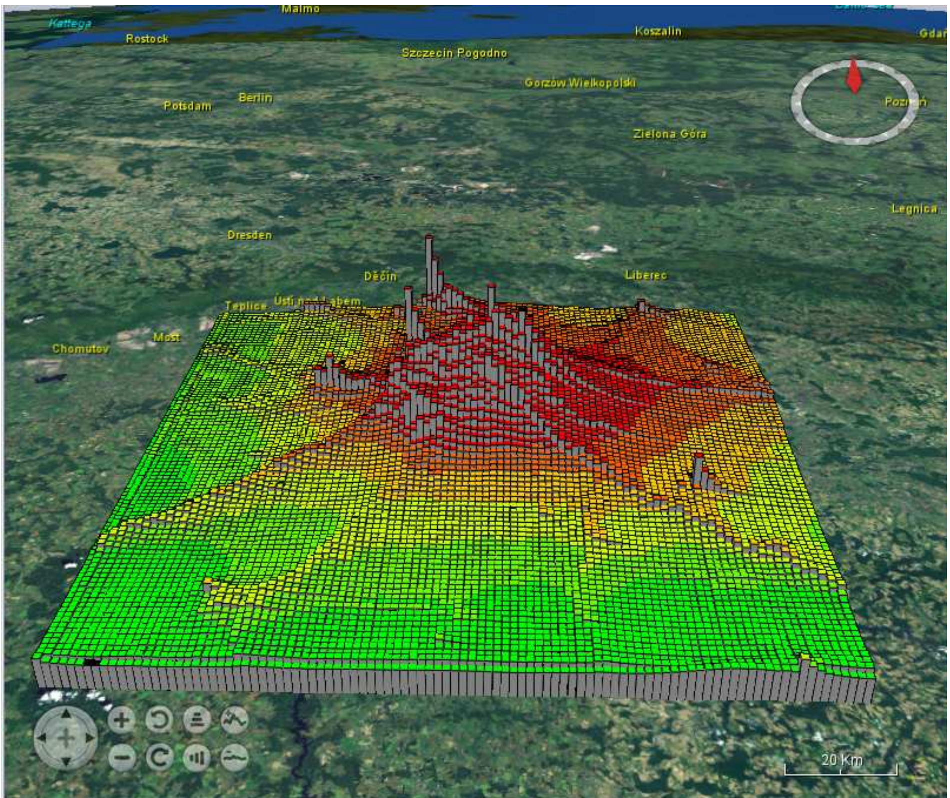

Figure 27: Annual mean of NO_2 [µg/m^3] in the Prague agglomeration as simulated by SUDPLAN Common Services downscaling in 2010, 3D visualization. The lines with higher concentration correspond to main road communications converging in Prague.

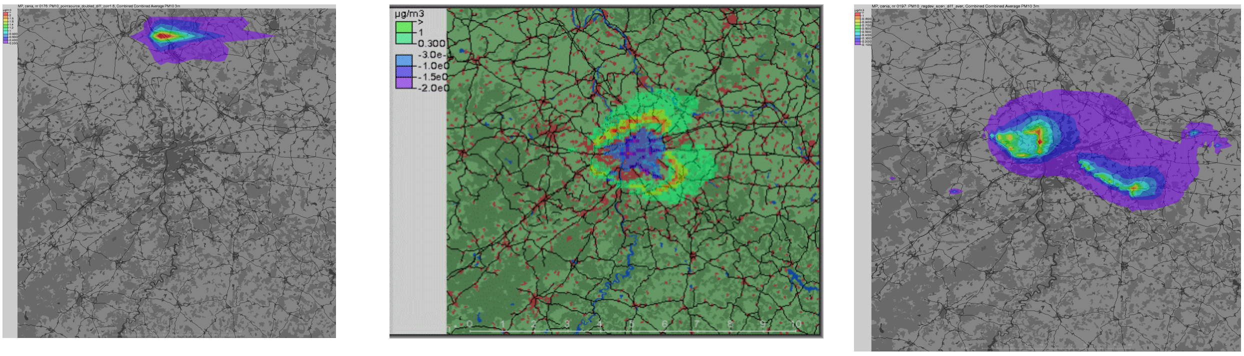

Figure 28: Assessment of differences in PM10 from three future scenarios, as compared to Baseline: Changed emissions from coal-fired power plant (left), completion of highway ring road around Prague (middle) and two new residential areas (right).

National INSPIRE Geoportal of the Czech Republic is built as an open standards and INSPIRE based solution, any WMS service can be displayed together with any other map service as long as they support S-JTSK projection. There are several dozens of predefined map compositions on the Geoportal sorted in several thematic categories based on INSPIRE annexes classification. It is possible to overlay SUDPLAN maps with any other map, adjust transparency of all layers, display attributes, see Figure 29. Geoportal is available at [http://geoportal.gov.cz/sudplan.](http://geoportal.gov.cz/sudplan) However given the freedom of virtually any possible map combinations and actions the Geoportal interface may be felt too advanced for ordinary users who might get interested just in air quality data, so it was decided to create a brand new web application focused on simple user interface and understandable publication and explanation of SUDPLAN data.

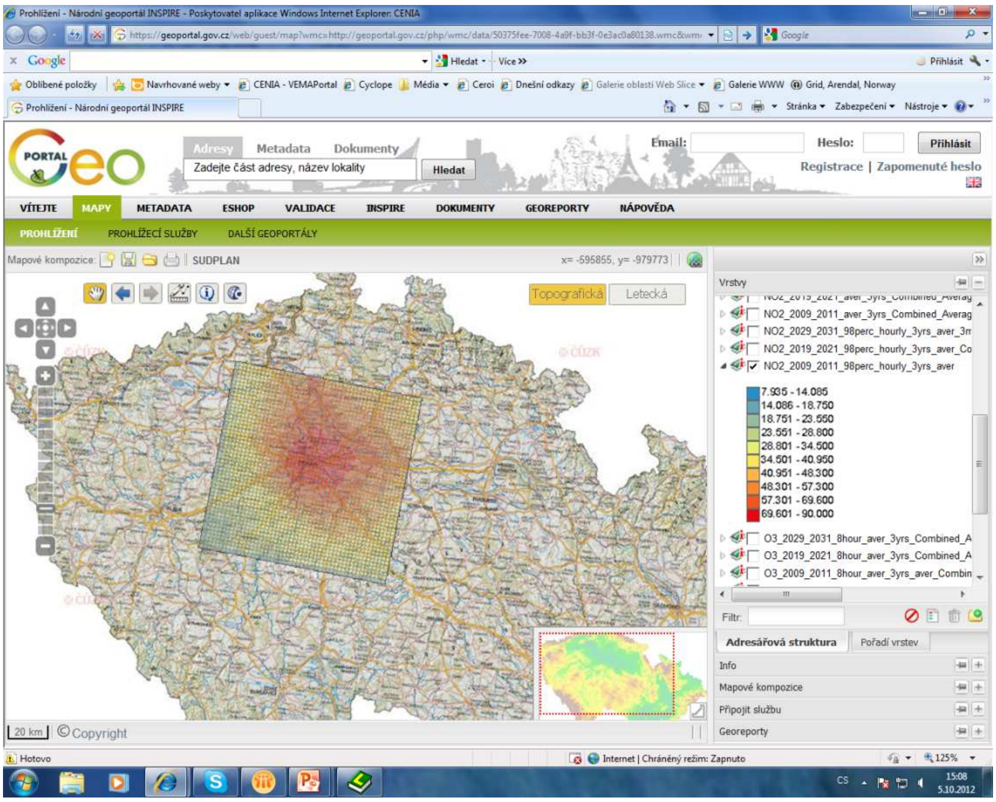

Figure 29: Presentation of Sudplan results on the INSPIRE Geoportal maintained by CENIA

The SUDPLAN Czech public application is based on ArcGIS for Server REST services. There are two types of services – dynamic for gridded SUDPLAN data and tiled for background layers of road map and aerial imagery. Users can switch between maps and scenarios; they can display legend and other explanations on what they see on the map. The application supports complete and seamless transition between Czech and English language version (Figure 30).

The application is available via this link: http://sudplan.cenia.cz

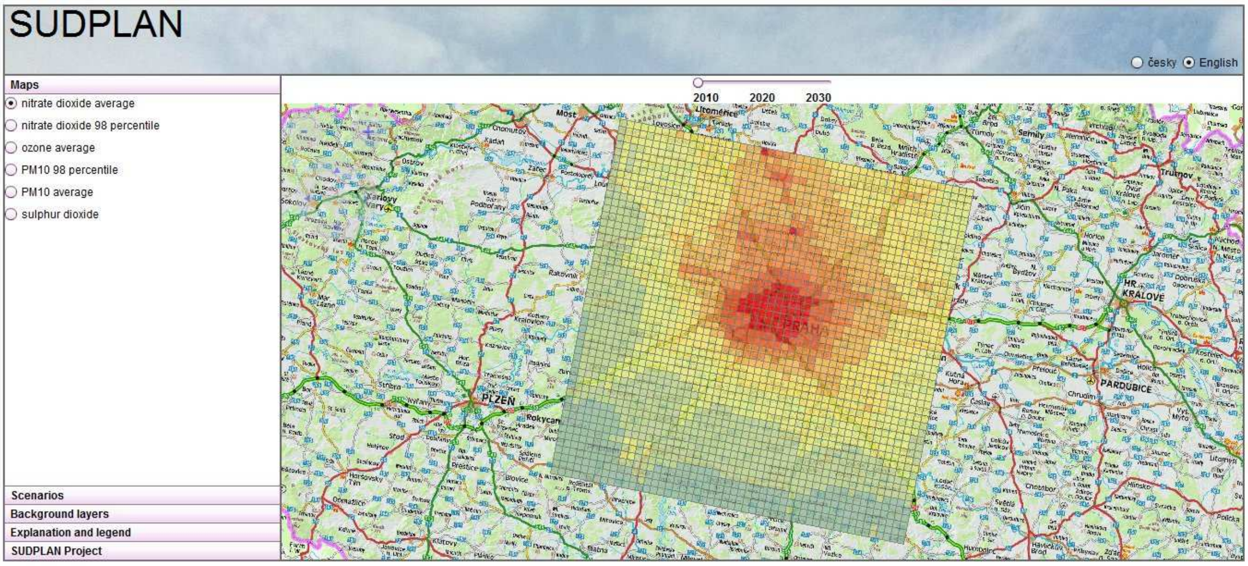

Figure 31: SUDPLAN public application as the presentation tool of the results of Czech Regional Pilot

4.1.3.8 Hydrology: Downscaling in Sweden

The Common Services hydrological tool uses the Hydrological Predictions for the Environment (HYPE) model, a dynamic, semi-distributed and process-based model based on well-known hydrological concepts. The HYPE model has been applied to simulate hydrological variables for all of Europe, in a Pan-European setup named E-HYPE. The SUDPLAN Pan-European database includes two climate scenario simulations (ECHAM5_A1B and HadCM3_A1B) for the period 1960-2100. For these scenarios, Common Services store information on river discharge, specific runoff, relative soil moisture and groundwater for spatial (about 37 000 sub-basins) and temporal (10-year/1-year/monthly/daily) visualisation. There is also statistical output for 30-year averages: the 10- and 50-year floods, mean annual high flow, mean annual low flow, number of days with hydrological drought, number of days with agricultural drought, intensity of agricultural drought, snow storage potential and maximum snow depth. The visualisation of those statistical maps shows the predicted future change in relation to the present situation (an example is given in Figure 31).

The Pan-European application of the HYPE model (E-HYPE 2.0) has a subbasin delineation with a median resolution of 215 km^2. The model application was calibrated against 80 gauging stations across Europe and validated to a further 860 stations. E-HYPE 2.0 includes detailed information for 166 of the largest lakes in Europe, specific rating curves and regulation routines for many of these large lakes, the use of quantitative evapotranspiration data for Europe and an updated glacier routine.

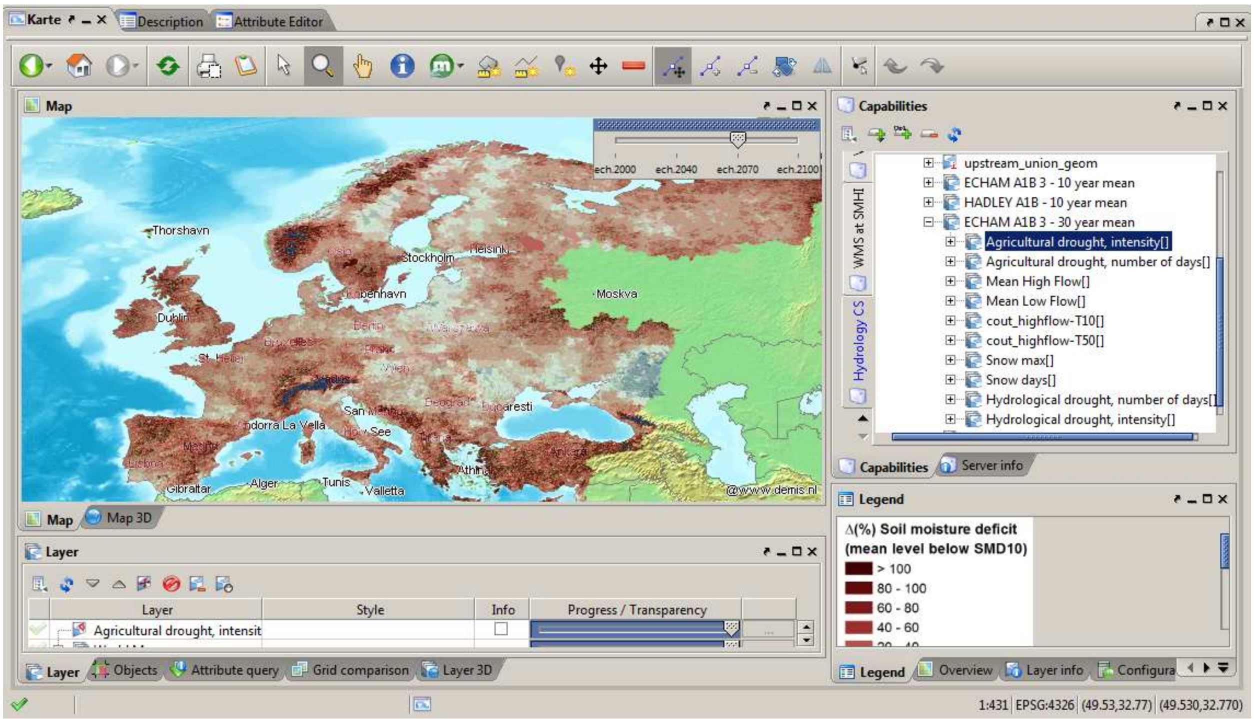

Figure 31: SUDPLAN visualization of Pan-European hydrological conditions (example difference in agriculture drought intensity year 2070 compared to present, according to ECHAM5_A1B scenario).

Common Services allows the user to produce improved hydrological model results (as compared to the pre-calculated E-HYPE results) by using additional local information that may be available (e.g. river discharge measurements) and optimizing the model calibration to the available local river discharge stations.

The hydrological downscaling is performed by creating a sub-model of the Pan-European hydrological model, E-HYPE, for the river or stream running through the specific city or region of interest and the catchment upstream of the point of interest on this river or stream. The validation of the Common Services hydrological application was made as a cooperation between partner SMHI and the Swedish Water Authority. One of the points of interest was Fällforsen, a small catchment area in northern Sweden (Figure 32).

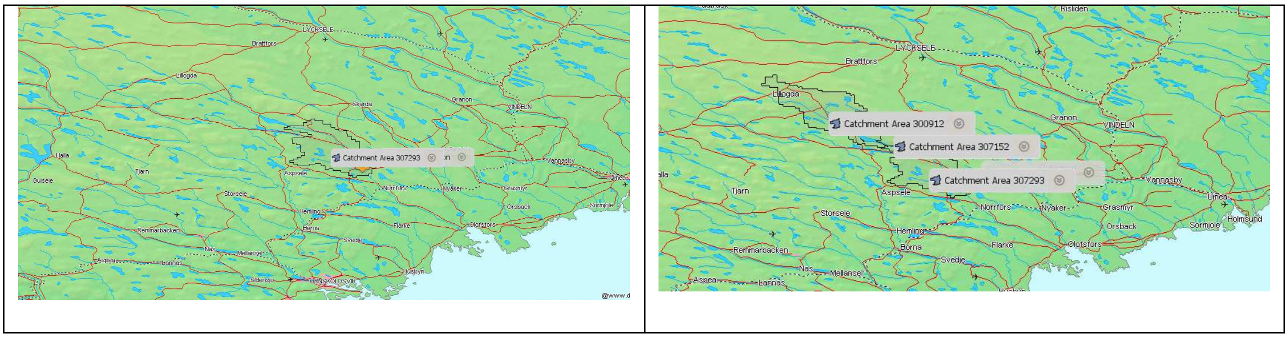

Figure 32: Hydrological downscaling in Fällforsen, northern Sweden. Subbasin of interest (left) and upstream basins (right).

An historical time series of measured river discharge (daily values) from Fällforsen was uploaded through the SMS GUI, thus serving as input to the re-calibration of the submodel for this particular area (Figure 33).

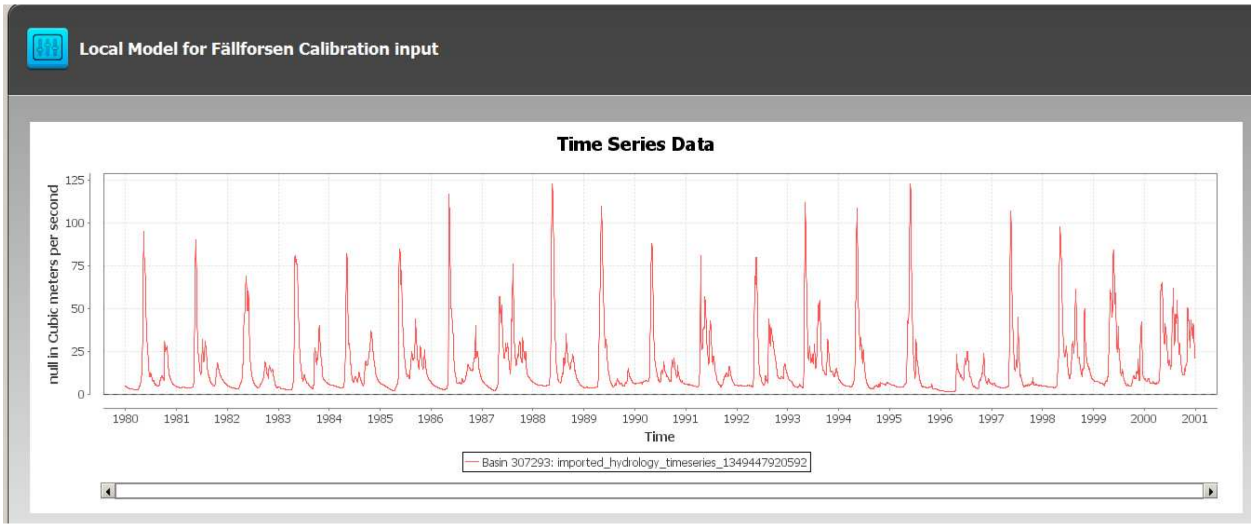

Figure 33: Input data for re-calibration of hydrological model for Fällforsen, Sweden.

Through the SMS GUI, the user can run an automatic calibration of the model to optimize model parameterization for this catchment. Once the new, local hydrological model is calibrated, it can be used to perform simulations based on selected climate scenarios. Note that unlike the other downscaling services, the spatial resolution of the output remains the same at European and local scales (i.e. the watershed and subbasin definitions of the downscaling application will be the same as for the Pan-European model). It is the calibration with local data that will improve the quality of the downscaled model output. Figure 34 indicate a considerable improvement for the Fällforsen site.

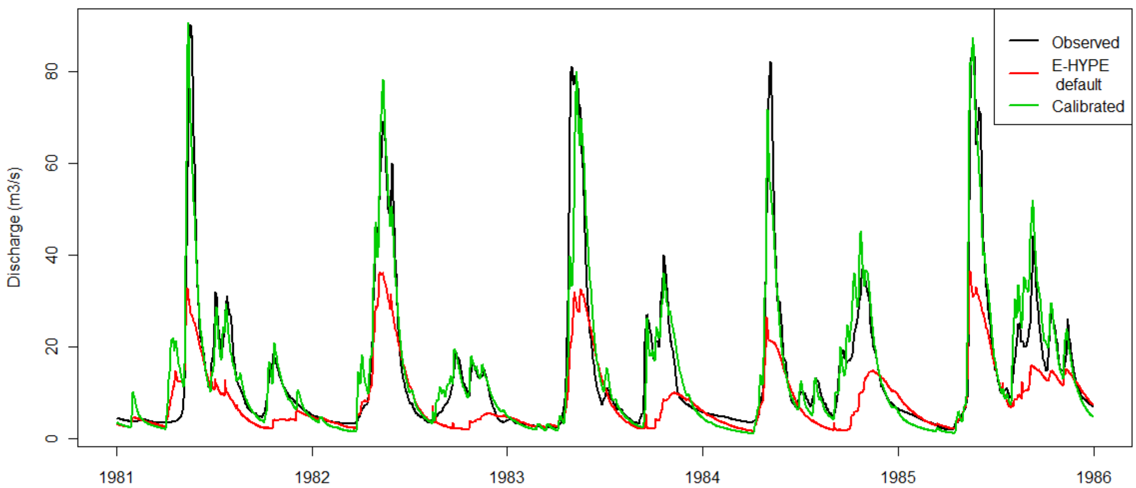

Figure 34: Comparison of monitored river discharge at Fällforsen (black line, same as input in Figure 30) with output from E-HYPE (red, default without local calibration) and output from calibrated model (green).

Once calibrated, the Fällforsen local model was executed with input from the two climate scenarios available, ECHAM5_A1B and HadCM3_A1B. Both scenarios indicate a small tendency of increasing river discharge (Figure 35). However, year-to-year fluctuations are considerable.

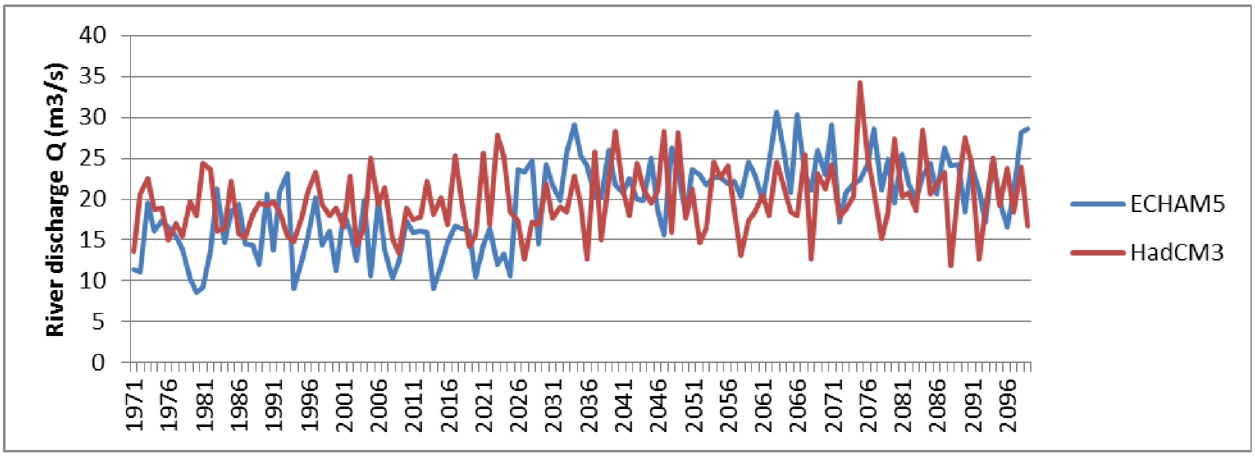

Figure 35: Projected river discharge at Fällforsen based on ECHAM5_A1B climate scenario (blue) and HadCM3_A1B (red).

4.1.3.9 Validation of the product

An annual validation procedure has been performed to get feedback and assure that the development of the SUDPLAN has been on track with end-user's requirements. The third and final validation was designed to reach as many project external end-users as possible, to know if the final product will be useful also for a larger community and to receive useful suggestions on improvements necessary for a "productification" of the tool.

A total of 57 persons, of which 33 were external to the SUDPLAN project, filled in the online survey with questions on the usability of the tool. Nearly all answers where very positive about SUDPLAN product, the available user interface, the models and the available data. Most persons also stated that the information provided by SUDPLAN was either new, of better quality or more useful as information available before. Also most participants of the survey found the graphical presentation of the SUDPLAN results excellent and contributing to a better understanding.

Although the graphical user interface was considered to work well, there were some persons that found it too complex. The SUDPLAN team is aware that the tool is not for all types of urban planners, certain skills and experiences from GIS and/or modelling systems are required for an efficient use. The important outcome from the validation result is that the final output was found of interest for all types of urban planners.

The validation has also generated a list of recommendations for post-project development, many of those related to support in use and interpretation of the results. Examples are online manuals, support in report and video generation, but also more far-reaching challenges like direct visualisation of uncertainties.

4.2 Use and Dissemination of foreground

4.2.1 Dissemination

The dissemination activities of SUDPLAN had defined its objectives as:

- to raise awareness of SUDPLAN, disseminate the results nationally and internationally
- to raise awareness of the scientific background in SUDPLAN common services in scientific forums such as journals and conferences
- to get stakeholder feedback and organise an exchange with experts
- to disseminate the results of SUDPLAN towards potential users and decision makers in regional- and local bodies responsible for planning

For this purpose the SUDPLAN website http://www.sudplan.eu has been the most important resource from which Newsletters, videos, deliverables and scientific results have been communicated to the public. However, partner's participation in scientific conferences has also been extensive and the consortium has organized two specific dissemination events. The first dissemination event targeted the scientific community and it was organized as a special session of the ISESS 2011 conference in Brno, Czech Republic. The second dissemination event was taking place October 2012 in Wuppertal, Germany, organized as a workshop "Climate Change and Urban Planning". This last event gathered more than 50 potential end-users of the SUDPLAN tool, i.e. people involved in urban planning.

Peer-reviewed publications produced by the SUDPLAN team:

- Contributions to a scientific book on extreme rainfall
- 3 open access publications in scientific journals
- 24 peer-reviewed conference papers (some also submitted to scientific journals)

A total of 78 formal deliverables are also available, many of those public and possible to download from the SUDPLAN portal. The titles of scientific publications and formal deliverables are listed in Section 5.

Meta-data of the climate, hydrological and air quality information on the Pan-European scale that has been generated during the project has entered the *Environment Climate Data Sweden* database (http://www.smhi.se/ecds/, Figure 36a-b-c). There the Common Services meta-data are fully searchable, with descriptions and indications on how data can be accessed. Through the SUDPLAN light, available from project website, the public can access and download all Pan-European information.

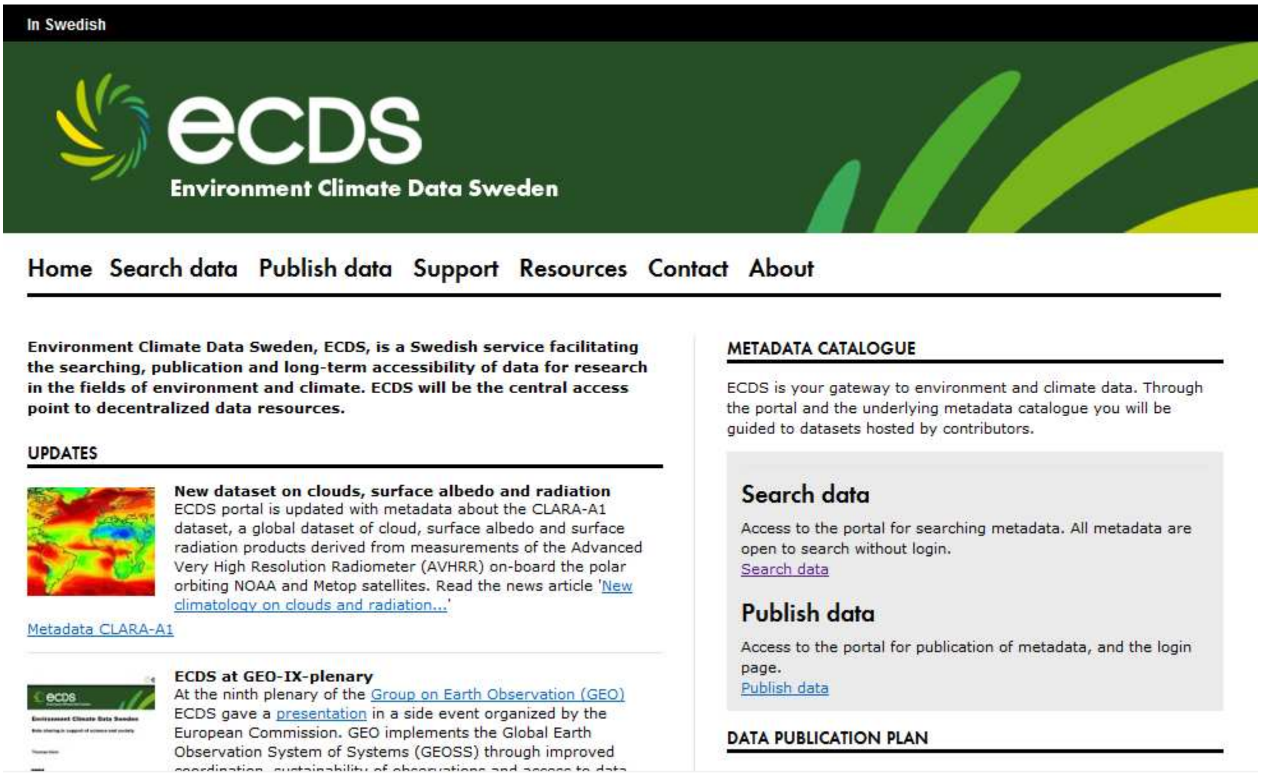

Figure 36a: The meta-data of the SUDPLAN Common Services information are reached through the ECDS database (http://www.smhi.se/ecds/): Opening page

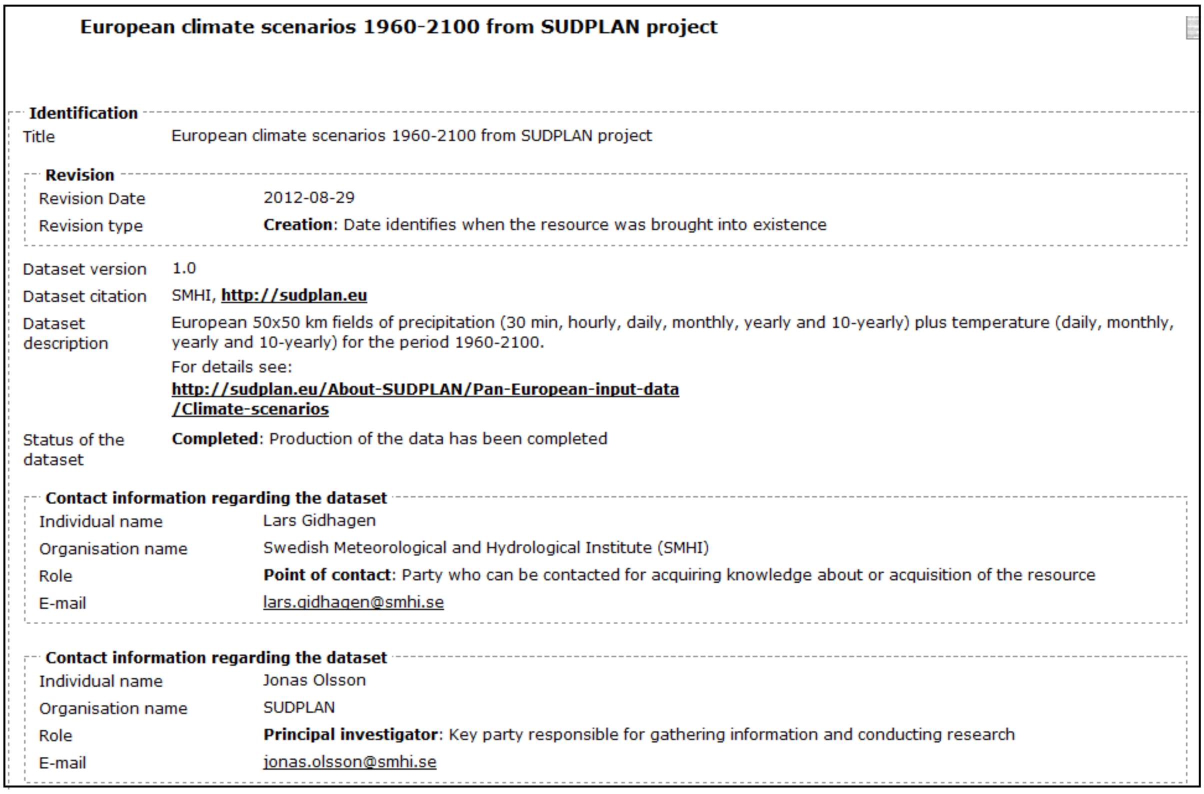

Figure 36b: The meta-data of the SUDPLAN Common Services information are reached through the ECDS database (http://www.smhi.se/ecds/): example of metadata for climate variables (1)

Format

Data format name	ASCII (point-wise time series)

OnLine resource

URL	http://sudplan.eu/
Description	The URL goes to the SUDPLAN portal, where data and software are described. The OGC compliant SOS (Sensor Observation Service) can be used to getCapabilities and getObservation (data), see project documentation under Results. An easier alternative is to use the SUDPLAN web client interface (SMS), available at the SUDPLAN web page **http://sudplanwp3.cismet.de/sms/run.html#Run_the_cismap_WMS_client_with_PE_Extension_from_the_web.** From the web client time series can be generated for whatever location in Europe, for different climate scenarios.

Data quality information

Scope of the quality report	Dataset
Quality report	Precipitation and temperature data comes from a Regional Climate Model output and may be biased as compared to measured data. Another SUDPLAN dataset offers climate scenario data that have been processed with Distribution Based Scaling algorithms, so called DBS-correced precipitaton and temperature.

Figure 36c: The meta-data of the SUDPLAN Common Services information are reached through the ECDS database (http://www.smhi.se/ecds/): example of metadata for climate variables (2)

4.2.2 Exploitation

During the project the consortium has discussed and developed the business perspectives after completion of the project. This includes an elaboration on the SUDPLAN offer, the potential markets and the role of each partner in exploitation. For a continued marketing of SUDPLAN results it was also necessary to establish business agreements between the members of the consortium. The exploitation plan, to be used after project completion, includes:

- A clear definition of the users of the SUDPLAN software
- A description of the SUDPLAN offer with its ***data dimension*** with environmental variables under climate change, the ***application domain*** in urban planning and the ***system features*** serving as an environmental decision support system.
- A discussion of the competitive advantages we have for supporting urban adaptation to climate change, this as compared to other software systems used in city planning that normally supports either climate change mitigation or assesses future scenarios without taking climate change into account.

- An exploitation strategy where partners their business profiles and how they can commercialize the SUDPLAN software.

- The results of a smaller market study with contributions from potential end users in Sweden.

- A plan to maintain the currently deployed demo system to be used by partners in their exploitation efforts during two years following the project.

- A list of multilateral business/exploitation agreements between partners that will assure present pilot cities to have operational access to SUDPLAN services and to allow the design, setup and operation of new commercial SUDPLAN services for future clients.

4.2.2.1 Exploitation Roadmap

The objectives of the exploitation activities after project for the period of 2013-2015 include to:

- Assure to have a demo system(s) available (already obtained)
- Use the individual contacts and opportunities from project exploitation
- Enhance and tailor the software towards the market needs
- Have 10 reference installations within the next 2 years (4 we have from the project)
- Address markets as identified in the market segmentation with priorities according to visible results

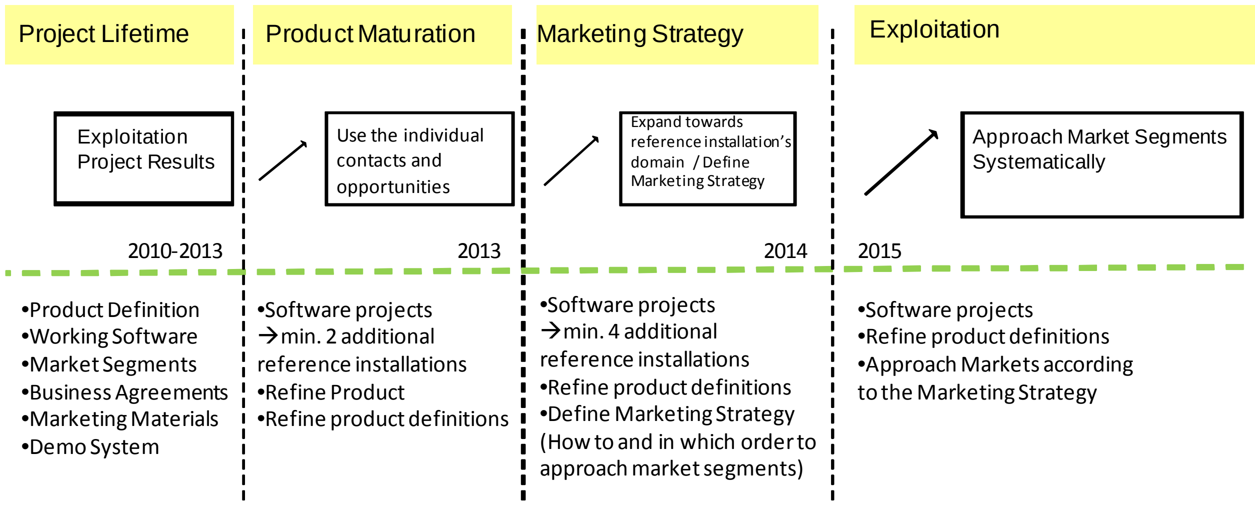

Figure 37: After project exploitation time line

4.2.2.2 Pricing

Urban planning software solutions based on SUDPLAN software will need to be developed in the course of software projects. The cost for these projects heavily depends on the software requirements on the particular solution. The calculations will include cost for customizing & software development, hosting, computation (super computing).

To implement these software development projects the SUDPLAN partners will build appropriate consortia like it has been already done for ongoing exploitation activities.

Section A (public)

TABLE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[1] (if available)	open access[2] provided to this publication?
1	*Von der Hochwasserrisikokarte zur Urbanen Gefährdungsanalyse – Methodik und Projekterfahrungen*	*Holger Hoppe et al.*	*DWA GIS & GDI 2012*	*January, 2012*	*DWA*	*Kassel, Germany*	*2012*	*17 pp*	*Request by email: heimann@dwa.de*	*No*
2	*Abschätzung von zukünftigen Entlastungsfrachten nach dem OWAV Regelblatt 19 aus Basis von Klimamodellprognosen am Beispiel der Stadt Linz*	*Valentin Gamerith et al.*	*Kanalmanagement 2012*	*February 2012*	*Wiener Mitteilungen (2012) Band 225, S. H1-19*	*Vienna, Austria*	*2012*	*19 pp*	*http://www.sudplan.eu/polopoly_fs/1.27758.1355488204!/KanMan_Gamerith_etal_SUDPLAN_final%20(Projectplace_83248).pdf*	*Yes*
3	*Assessment of Future Urban Air Quality considering Climate Change Effects*	*Lars Gidhagen et al.*	*Air Quality – Science and Application 2012*	*March 2012*	*Air Quality – Science and Application (conference)*	*Athens, Greece*	*2012*	*poster*	*http://www.sudplan.eu/polopoly_fs/1.27719!AQC2012_GidhL00675_poster.pdf*	*Yes*
4	*Future IDF curves for regional planning in Europe - a SUDPLAN result*	*Peter Kutschera et al.*	*EGU 2012*	*April 2012*	*European Geophysical Union*	*Vienna, Austria*	*2012*	*poster*	*http://www.sudplan.eu/polopoly_fs/1.21737!2012-04-26_SUDPLAN_IDF_Poster_EGU-*	*Yes*

[1] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[2] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

									final_A4.pdf	
5	*Überflutungsvorsorge und integrierte Stadt-entwässerung im Zeichen des Klimawandels: Informationsmanagement und -visualisierung am Beispiel des EU-FP7 Projekts SUDPLAN*	*Holger Hoppe et al.*	*Aqua Urbanica 2012, München*	*May 2012*	*Schriftenreihe Fachgebiet Siedlungswasserwirtschaft Band 32, TU Kaiserslautern*	*München, Germany*	*2012*	*23 pp*	*http://www.sudplan.eu/polopoly_fs/1.27771.1355489809!/C_Hoppe_et_al_Aqua_Urbanica.pdf*	*Yes*
6	*Downscaling of Short-Term Precipitation from Regional Climate Models for Sustainable Urban Planning*	*Jonas Olsson et al.*	*-*	*May 2012*	*Sustainability (journal)*	*-*	*2012*	*12 pp*	*doi:10.3390/su4050866*	*Yes*
7	*Assessment of Combined Sewer Overflows under Climate Change Urban Drainage Pilot Study Linz*	*Valentin Gamerith et al.*	*IWA-WCE 2012*	*May 2012*	*IWA World Congress on Water, Cliamte and Energy*	*Dublin, Ireland*	*2012*	*9 pp*	*http://sudplan.eu/polopoly_fs/1.24829.1347460676!/Paper_WCE_Dublin_Gamerith_et al.pdf*	*Yes*
8	*Considering the Impact of Future Climate Change on the Resilience of a City – Surface Run-Off due to Heavy Storm Events in the City of Wuppertal*	*Frank Michel et al.*	*RealCORP 2012*	*May 2012*	*International Conference on Urban Planning and Regional Development in the Information Socieity*	*Schwechat, Austria*	*2012*	*10 pp*	*http://corp.at/archive/CORP2012_148.pdf*	*Yes*
9	*Modeling Effects of Climate Change on Air Quality and Population Exposure in Urban Planning Scenarios*	*Lars Gidhagen et al.*	*-*	*July 2012*	*Advances in Meteorology (journal)*	*-*	*2012*	*12 pp*	*doi:10.1155/2012/240894*	*Yes*
10	*Integration of Climate Change Effects in Local Models and Urban Planning Processes*	*Sacha Schlobinski*	*IEMSS 2012*	*July 2012*	*Intern. Congress on Environmental Modelling and Software Managing Resources of a Limited Planet*	*Leipzig, Germany*	*2012*	*9 pp*	*http://www.iemss.org/sites/iemss2012/proceedings/C3_0574_Schlobinski_et_al.pdf*	*Yes*
11	*Scientific Data Management with Open Source Tools – An Urban Drainage Example*	*David Camhy et al.*	*UDM 2012*	*September 2012*	*Urban Drainage Modelling 2012*	*Belgrade, Serbia*	*2012*	*11 pp*	*(not yet)*	*(not yet)*
12	*Global Sensitivity Analysis and Multi-Objective Optimisation for*	*Valentin Gamerith*	*UDM 2012*	*September 2012*	*Submitted for publication to Water*	*Belgrade, Serbia*	*2013?*	*11 pp*	*(not yet)*	*(not yet)*

	Estimation of Combined Sewer Overflows – Case Study Linz	*et al.*			*Science and Technology (journal)*					
13	*SUDPLAN: Developing a Decision Support System to Cope with Climate Change - Urban Drainage Pilot Linz*	*Guenter Gruber et al.*	*WWC IWA 2012*	*September 2012*	*Submitted for publication to Water Science and Technology (journal)*	*Busans, Corea*	*2013?*	*9 pp*	*(not yet)*	*(not yet)*
14	*Long-term air quality projections for Prague and Central Bohemia Region: Application of the SUDPLAN modelling tool.*	*Vladislav Bizek, Jan Mertl et al.*		*December 2012*	*Submitted for publication in Czech journal Air Quality Protection (in Czech language)*	*Prague*	*2013*		*(not yet)*	*(not yet)*
15	*Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems*	*Jonas Olsson et al.*	*IWA book series*	*September 2012*	*IWA book series*	*-*	*2012*	*19 pp*	*http://www.iwapublishing.com/template.cfm?name=isbn9781780401256*	*Yes*
16	*European summer surface ozone 1990-2100*	*Joakim Langner et al.*	*-*	*November 2012*	*Atmospheric Chemistry and Physics (journal)*	*-*	*2012*	*9 pp*	*doi:10.5194/acp-12-10097-2012*	*Yes*
17	*A decision support system for urban climate change adaptation.*	*Ralf Denzer et al.*	*HICSS-44*	*January 2011*	*Proceedings of the 44th Hawaii Intern. l Conference on System Sciences (HICSS-44), IEEE Computer Society, January 2011.*	*CDROM*	*2011*	*10 pp*		*No*
18	*E-HypeWeb: Service for water and climate information – and future hydrological collaboration across Europe Environmental Software Systems.*	*Berit Arheimer et al.*	*ISESS 2011*	*June 27-29, 2011*	*Frameworks of eEnvironment - 9th IFIP WG 5.11 International Symposium, ISESS 2011, Brno, Czech Republic*		*2011*	*10 pp*	*DOI: 10.1007/978-3-642-22285-6_71.*	*No*
19	*Web services for incorporation of air quality and climate change in long-term urban planning for Europe.*	*Magnuz Engardt et al.*	*ISESS 2011*	*June 27-29, 2011*	*Frameworks of eEnvironment - 9th IFIP WG 5.11 International Symposium, ISESS 2011, Brno, Czech Republic*		*2011*	*8 pp*	*DOI: 10.1007/978-3-642-22285-6_60.*	*No*

20	*SUDPLAN's experience with OGC-based model web services for the climate change usage areas*	*Peter Kutschera et al.*	*ISESS 2011*	*June 27-29, 2011*	*Frameworks of eEnvironment - 9th IFIP WG 5.11 International Symposium, ISESS 2011, Brno, Czech Republic*		*2011*	*16 pp*	*DOI: 10.1007/978-3-642-22285-6_64.*	*No*
21	*Downscaling of short-term precipitation time series for climate change impact assessment*	*Jonas Olsson et al.*	*ISESS 2011*	*June 27-29, 2011*	*Frameworks of eEnvironment - 9th IFIP WG 5.11 International Symposium, ISESS 2011, Brno, Czech Republic*		*2011*	*6 pp*	*DOI: 10.1007/978-3-642-22285-6_67.*	*No*
22	*Integrating climate change in the urban planning process – a case study. Environmental Software Systems*	*Stefan Sander et al.*	*ISESS 2011*	*June 27-29, 2011*	*Frameworks of eEnvironment - 9th IFIP WG 5.11 International Symposium, ISESS 2011, Brno, Czech Republic*		*2011*	*10 pp*	*DOI: 10.1007/978-3-642-22285-6_68.*	*No*
23	*Vision and requirements of scenario-driven environmental decision support systems supporting automation for end-users Environmental Software Systems*	*Sascha Schlobinski et al.*	*ISESS 2011*	*June 27-29, 2011*	*Frameworks of eEnvironment - 9th IFIP WG 5.11 International Symposium, ISESS 2011, Brno, Czech Republic*		*2011*	*13 pp*	*DOI: 10.1007/978-3-642-22285-6_6.*	*No*
24	*Sensor Web Enablement based Model Web Implementation for Climate Change Applications*	*Mihai Bartha et al.*	*EnviroInfo 2011*	*October 5-7, 2011*	*25th International Conference on Environmental Informatics, EnviroInfo 2011, Ispra, Italy*		*2011*	*15 pages*	*(still not available)*	*Yes*
25	*Towards Automation of Model Execution from a Decision Support Environment*	*Ralf Denzer et al.*	*MODSIM 2011*	*December 2011*	*Modelling and Simulation Society of Australia and New Zealand December 12 - 16 2011, Perth, Australia*		*2011*	*7 pages*	*http://www.mssanz.org.au/modsim2011/C4/denzer.pdf*	*Yes*
26	*Uncertainties in future air*	*Lars*	*MODSIM*	*December*	*Modelling and*		*2011*	*7 pages*	*http://www.mssanz.or*	*Yes*

	quality: a scientific workflow tool	*Gidhagen et al.*	*2011*	*2011*	*Simulation Society of Australia and New Zealand December 12 - 16 2011, Perth, Australia*				*g.au/modsim2011/E1/gidhagen.pdf*	
27	*Short-term rainfall downscaling from Regional Climate Models by extended Delta Change, Sustainability*	*Jonas Olsson*		*December 2011*			*2011*		doi:10.3390/su4050866	
28	*Sustainable Urban Development Planner for Climate Change Adaptation (SUDPLAN)*	*Lars Gidhagen et al.*	*ENVIP 2010*	*Oct 06-08, 2010*	*Berre, A.; Roman, D.; Maué P., Proceedings of ENVIP'2010 workshop at EnviroInfo2010, "Environmental Information Systems and Services - Infrastructures and Platforms", Bonn, October 6-8, 2010,CEUR-WS, Vol-679, ISSN 1613-0073, urn:nbn:de:0074-679-9*		*2010*	*1-11*	*http://sunsite.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-679/paper3.pdf* *(also linked from www.sudplan.eu, under "Results")*	*Yes*

Table 1: List of scientific (peer reviewed) publications

TABLE A2: LIST OF DISSEMINATION & EXPLOITATION ACTIVITIES DURING 2012

NO.	Type of activities	Main leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	*Meeting and presentation for external end-users in Stockholm : - Marie Westin, Trafikverket - Marianne Klint, WSP*	*Christer Johansson, Lars Gidhagen*	*Presentation of the Stockholm Pilot results for the two responsible of the environmental consequences of the large road project, focus for the Stockholm Pilot*	*February 2, 2012*	*Stockholm, WSP office*	*Urban planners, experts in environmental impact of road traffic*	*2 experts*	*Sweden*
2	*Interview responsible for Water and Sewerage Norrköping*	*Johanna Fältström*	*Presentation SUDPLAN, discussion to get input to market analysis*	*February 12, 2012*	*SMHI, Norrköping*	*Former employee Norrköping Vatten*	*1 expert*	*Sweden*
3	*Meeting Swedish Water (national association)*	*Johanna Fältström, Jonas Olsson*	*Presentation SUDPLAN, discussion to get input to market analysis*	*March 16, 2012*	*Stockholm*	*Experts from Swedish Water association*	*3 experts*	*Sweden*
4	*Meeting with Gothenburg Water*	*Johanna Fältström*	*Presentation SUDPLAN, discussion to get input to market analysis*	*March 29, 2012*	*Gothenburg*	*Gothenburg Water*	*2 experts*	*Sweden*
5	*Presentation/workshop*	*Jan Mertl*	*Presentation of interim results of the Czech Pilot to the representatives of the Ministry of Environment and Czech Hydro meteorological Institute*	*April 17, 2012*	*Ministry of the Environment*	*Policy makers, high level officials, air quality experts*	10 people	Czech Republic
6	*Meeting with IF insurance company*	*Johanna Fältström*	*Presentation SUDPLAN, discussion to get input to market analysis*	*May 7, 2012*	*Stockholm*	*IF insurance company*	*2 experts*	*Sweden*
7	*Meeting with Sweco (big consultant company)*	*Johanna Fältström*	*Presentation SUDPLAN, discussion to get input to market analysis*	*June 25, 2012*	*Stockholm*	*Sweco (one of the biggest consultant companies in*	*1 expert*	*Sweden, Africa*

						Sweden)		
8	*Meeting with external users of the SUDPLAN product*	*Jan Mertl*	*SUDPLAN presentation to the representatives of the Municipality of Prague and the City Development Authority of Prague*	*August 15, 2012*	*CENIA*	*Urban planners, policy makers on regional level*	3 people	Czech Republic
9	*Meeting with Ulla Bertils, Swedish Environmental Agency*	*Lars Gidhagen*	*Presentation of SUDPLAN*	*August 23, 2012*	*SMHI, Norrköping*	*Environmental expert, policy maker*	*1 expert*	*Sweden*
10	*Visit of the "Working group of the city planners in the association of cities in Rhineland-Palatine (AGSIS)*	*Frank Michel*	*Sustainable urban planning and climate change adaptation*	*Aug 26th 2012*	*Kaiserslautern, DE*	*City planners and decision makers*	15-20	Germany
11	*Workshop 1 for Hydrology evaluation for Swedish Water Authority*	*Lena Strömbäck, Jonas Olsson, Lars Gidhagen*	*Prestation and live demo of SUDPLAN, training and planning for external end-user evaluation of the system*	*September 06, 2012*	*SMHI, Norrköping*	*Experts in hydrology, GIS, IT from Swedish Water Authorities*	*5 experts*	*Sweden*
12	*SUDPLAN 2nd Dissemination event : Climate Change and Urban Planning*	*SUDPLAN consortium*	*Halfday 1: Keynote lectures, presentation SUDPLAN results Halfday 2: Live demonstrations of SUDPLAN tool in four stations*	*October 11-12, 2012*	*Wuppertal, Germany*	*Experts involved in urban planning*	*>50 experts*	*9 countries*
13	*Workshop for Estionian delegation interested in hydrology and climate change impact*	*Lars Gidhagen*	*Presentation and live demo of SUDPLAN*	*November 01, 2012*	*SMHI, Norrköping*	*Environmental experts from Estonian Environmental Ministry and Estonian Environmental Research Centre*	*7 experts*	*Estonia*
14	*"Night of science" / open house @ DFKI*	*Daniel Steffen*	*Kaiserslautern Emotional - How do you feel in your city?*	*Nov. 9th 2012*	*Kaiserslautern, DE*	*General public*	300-400	Germany

15	*WP5 workshop with Stockholm Water and other authorities*	*Christer Johansson, Boel Lövenheim, Lars Gidhagen*	*Presentation and live demo of SUDPLAN downscaling Rainfall, Hydrology & Air Quality*	*November 12, 2012*	*Stockholm Environment and Health Administration*	*Stockholm Water,*	*6 urban planners*	*Sweden*
16	*SUDPLAN WP7 live SMS presentation for sewerage planning division at Linz AG*	*TU Graz (G. Gruber)*	*SUDPLAN WP7 live SMS presentation and discussions*	*November 13, 2012*	*Linz AG*	*Sewerage planner of LINZ AG (primary end-users)*	3	Austria. LINZ AG
17	*SUDPLAN WP7 presentation for scientific project at Kepler-Gymnasium in Graz*	*TU Graz (G. Gruber)*	*SUDPLAN WP7 overview presentation*	*November 23, 2012*	*TU Graz*	*Pupils and Gymnasium*	2 pupils	Austria, Gymnasium (school)
18	*Regional seminar on Climate Change – Mitigation and Adaptation*	*Lars Gidhagen*	*SUDPLAN: utilisation de scénarios climatiques dans la planification urbaine*	*November 26-29, 2012*	*Cotonou, Benin*	*Experts in Climate Change from West Africa*	*30 experts*	*West Africa*
19	*Seminar hold at TU Graz for wastewater and sewerage experts for the authority of the federal state of Styria*	*TU Graz (G. Gruber et al.)*	*"Abschätzung des Einflusses von Klimawandel auf die Mischwasserentlastungen im Einzugsgebiet Linz"*	*November 27, 2012*	*TU Graz*	*Wastewater and sewerage experts for the authority of the federal state of Styria*	30	Austria, Styria
20	*Workshop 2 for Hydrology evaluation for Swedish Water Authority*	*Lena Strömbäck*	*Summing up results of the Swedish Water Authority experiences while testing SUDPLAN*	*November 28, 2012*	*Video conference*	*Swedish Water Authority*	*3 hydrological experts*	*Sweden*
21	*Web announcement, press release*	*JMe*	*Official launch of the SUDPLAN application (http://sudplan.cenia.cz) and the presentation of SUDPLAN results on INSPIRE Geoportal (http://geoportal.gov.cz/sudplan)*	*December 2012*	*CENIA*	*Decision makers in public administration, air quality experts, public*	*unlimited*	*International*
22	*SUDPLAN WP7 live SMS*	*TU Graz*	*SUDPLAN WP7 live SMS*	*December*	*TU Graz*	*IT-Expert (Ralf*	1	Austria and

	presentation for planned exploitation activities in Austria and Europe	(G. Gruber)	presentation and discussions about future exploitation activities in Austria and Europe	7, 2012		Denzer)		Europe
23	Regular meeting SULVF board	Lars Gidhagen	Presentation of the Stockholm Pilot results	December 7, 2012	Stockholm	Steering board of SULVF (partner)	15 board members	Sweden
24	Meeting National Knowledge Center for Climate Change Adaptation	Lars Gidhagen	Discussing how SUDPLAN can support adaptation work	December 21, 2012	SMHI, Norrköping	Manager for National Knowledge Center for Climate Change Adaptation	2 climate experts	Sweden
25	Oral presentation at HICCS-44	R Denzer	(see Table A1 paper 1)	January 2011	Hawaii	scientific		
26	Poster presentation at European Geosciences Union, EGU 2011	P Kutchera, D Havlik, M Bartha	OGC SWE compliant implementation of the model web in the climate change domain	April 3-8, 2011	Vienna, Austria	scientific		
27	Six oral presentations at ISESS 2011	P Wallman, M Engardt, P Kutchera, J Olsson, S Sanders, S Schlobinski	(see Table A1 paper 2-7)	June 27-29, 2011	Brno, Czech Republic	scientific	100	DE,AU,CZ,DK, UK,IT,NO,FI,GR, Australia,Canada, USA
28	EnviroInfo 2011 (oral and poster presentation)	L. Gidhagen, P. Kutschera	Oral: See A1 paper 8 Poster: SUDPLAN-an ICT Planning Tool for Sustainable Urban Development…..	October 5-7, 2011	JRC/Ispra, Italy	Policy makers, scientific community	200	NO, SV, DE, AU, CZ, UK, SL, FR, IT, ES, GR, BE, SP,SUI
29	UAQCC 2011 (oral presentation)	Magnuz Engardt	High-resolution photochemical modeling of air quality in Stockholm	August 16-18, 2011	Hamburg, Germany	Scientific		DE,AU,DK, UK,FR IT,NO,FI,GR,US, MEX,NE,Australia,

			-Current and future situation					*BE,East Africa*
30	*World Water Week 2011 : water in an urbanising world (oral presentation and a 15 min movie projected in a portable geodome)*	*Jonas Olsson*	*Oral: Regional climate model projections for urban hydrological planning and adaptation: the SUDPLAN project. Geodome (movie): Urban water vision*	*August 21-27, 2011*	*Stockholm, Sweden*	*Policy makers, scientific community*	*>2500*	*Many…*
31	*Urban hydrology and storm water management*	*Jonas Olsson*	*Oral (invited): Climate adaptation: analyses of model results and development of tools*	*November 9-10, 2011*	*Lund, Sweden*	*Scientific community, professionals*		*SE*
32	*Swedish Journal «Vatten » : press release and open invitation to Swedish stakeholders to test and give feedback on SUDPLAN rainfall downscaling*	*Jonas Olsson*	*Press release: SUDPLAN: research project for supporting climate adaptation of cities sewage systems*	*November 2011*	*Swedish journal "Vatten" (Water)*	*Scientific community, professionals*		*SE*
33	*Workshop "Flooding prevention in urban drainage » Überflutungsvorsorge in der Stadtentwässerung)" by DR. PECHER AG and WSW Energie & Wasser AG*	*Stefan Sander*	*30 min. lecture on the SUDPLAN project*	*November 3, 2011*		*predominantly regional experts for urban drainage from municipalities and utilities*		*DE*
34	*Conference "Kommunale Anpassungsstrategien an den Klimawandel (Local adaption strategies to climate change)" by "Deutsches Institut für Urbanistik (DIFU), Servicestelle: Kommunaler Klimaschutz" Filmlet, produced for every single awardee of the of the above-mentioned contest Workshop "Effect of climate*	*Bernard Arnold*	*Awards ceremony of contest "Sich zukunftsweisend wandeln - jetzt handeln: Anpassungspioniere gesucht!" (WUP is one of four prize winners of the above-mentioned contest) as part of the*	*December 12 2011*		*journalists reaching both the general public in Germany and experts, experts in the fields of climate change, civil protection,*		*DE*

	change and provisions"					*urban drainage and urban administration*		
35	*SUDPLAN presentation at ENVIP2010 (oral presentation)*	*Denis Havlik*	*(see Table A1)*	*Oct 08, 2010*	*Bonn, DE*	*Scientific community*	*50-100*	*NO, SV, DE, AU, CZ, UK, SL, FR, IT, ES, GR, BE*
36	*EnviroInfo 2010 (poster presentation)*	*Martin Weller*	*Visualization for Climate Change Adaptation in SUDPLAN*	*Oct 06-08, 2010*	*Bonn/Cologne,DE*	*Scientific community*	*100*	*NO, SV, DE, AU, CZ, UK, SL, FR, IT, ES, GR, BE*
37	*Asia Pacific Association of Hydrology and Water resources (poster presentation)*	*Jonas Olsson*	*Facilitating Urban Hydrological Climate Chante Impact Assessment in Europe*	*Nov 9-10, 2019*	*Hanoi, Vietnam*	*Scientific community*	*200*	*25 nationalities, mostly Asian*
38	*Road dust - health effects and abatement strategies: seminari in Stockholm during celebration of "First European Green Capital" (distribution of SUDPLAN leaflets, references to SUDPLAN web page)*	*Christer Johansson*		*October 18-19, 2010*	*Stockholm,SE*	*Decision makers, NGOs, scientific community*	*100*	*Nordic countries, Germany, Italy*
39	*Meeting EPA Austria*	*Hubert Hahn*	*Presentation of SUDPLAN and other projects at AIT*	*Aug 30, 2010*	*Umweltbundesamt Vienna, AT*	*Policy makers*	*3*	*AT*
40	*IFAT ENTSORGA - trade fair for environmental technology (distr. of SUDPLAN leaflets)*	*Günter Gruber*		*September 13-17, 2010*	*Munich, Germany*		*(110 000)*	*(185 countries)*

Table 2: List of Dissemination & Exploitation Activities